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PERSPECTIVES on Science and Christian Faith

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Editorial

On Boundaries: Let Science Be Science? Let Religion Be Religion?



Arie Leegwater

In a perceptive article (Journal of Religion 86 [2006]: 81–106) Peter Harrison, Andreas Idreos Professor of Science and Religion at Oxford University, describes how the dual categories of science and religion have been invented over time. Not only are the boundaries of science in flux, only becoming somewhat stable in the nineteenth century, but so are those of religion, having been constructed earlier during the European Enlightenment, usually in terms of a set of propositional beliefs. This demarcation or boundary issue, what is properly science and what is properly religion, has also exercised the Christian community, including ASA.

Perhaps a historical example can help illumine what I mean. Charles Alfred Coulson, an English quantum chemist, gave a lecture at the 1951 British Association for the Advancement of Science meeting entitled, "The Place of Science in the Christian Faith." He was present at the invitation of Oliver R. Barclay, who represented the selection committee of the Research Scientists' Christian Fellowship. Besides the invitation extended to Coulson, Barclay also offered some ideas for a suitable topic:

I do not know what you have in mind for a subject. I would suggest something along the lines of fairly fundamental apologetics would be best, e.g., something on "The Difficulties for Christian Faith raised by a Scientific Attitude," or perhaps something on "Materialism and Christian Faith."¹

Although Coulson did not follow the advice, Barclay thanked Coulson for the lecture, but expressed several reservations: one of these was that Coulson considered science to be a religious activity. This claim revealed some of the fundamental differences in interpretation between the two correspondents. The nuances are partially reflected in the use of the preposition "in" found in Coulson's title, "The Place of Science in the Christian Faith," and by Barclay's preference for using the preposition "for" [for Christian Faith] and the conjunction "and" [and Christian Faith] in his suggested lecture titles. Barclay argued that science should be a religious activity and can be for a Christian, but, in no sense, can science be religious for an atheist without thereby degrading the word "religious." For Barclay, religion and science were seen as complementary. For Coulson, science seen as a religious activity was "significant in terms of the process of appeal to a larger body of professional scientists."² For him, religion and science were not complementary, but inherently intertwined and related.

If what I have said is even faintly true, then scientific enquiry holds within itself the stuff of religious search. This is true in two senses – first, that the scientist himself keeps on coming up against feelings and convictions with an unmistakably spiritual content; second, that his work is essentially religious.³

Coulson identified some of these convictions:

[T]hat this world is not alien to us, but that its secret may be revealed to those who seek; that truth is accessible, and that mental integrity is both possible and necessary in its apprehension; that the criteria by which we judge the acceptance or rejection of some new scientific theory contain some elements which lie outside our particular culture, and other elements which lie within it; that the patience, the austerity, the self-discipline without which science cannot prosper are not mere techniques, but are somehow fundamental to the search.⁴

For Coulson, science and religion were expressions of a deeper unity that rested on a personal act of reflection. For him, science and religion did not represent contiguous harmonious domains, nor were

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they at war or in conflict with each other. They were intimately related, but not in a complementary fashion. Their intimate relationship depended on personal experience, which could be partially communicated to others, but ultimately was exclusive. In our act of reflection on our experiences, which come to us and which are sought, we engage in an essentially religious activity:

To accept Nature as, in some senses, given: to receive the gift, and behave in a creaturely fashion towards it: to believe that it carries with it meaning and significance; and to seek, in reflection, what that meaning is – this surely is to act religiously. But in that event, religion is not merely one view of the mountain [the world, AL]. It is some attitude which colours all the separate views, and gives them a depth which otherwise they would lack, more or less as a vellow filter reveals a pattern of clouds in a sky that without it appears pure blue. This attitude, without which we do not get the full value of our studies, or gain full understanding of our environment, cannot properly be described, because, although it falls within the field of human experience, it does not lie within that part which is susceptible of rational discourse.⁵

For Coulson, "religion is the total response of man to all his environment." The word total is crucial. By it Coulson meant to convey the whole person: thought, emotion, human relationships, and so forth. Similarly, the term environment included everything: things in heaven and in earth.

I favor Coulson's take on these matters. We may engage science as active participants in its investigative regimen or as casual observers and commentators of its grand theories, but religion is not something we engage. We may participate in religious practices, cultic events, worship services, but life lived is religion. Only then, I think, will we do justice to a person such as Charles Coulson and his efforts to consider religion not as irrelevant *to*, or in conflict *with*, or simply an influential factor *on*, but rather as the very *ground* for scientific practice. *

Notes

¹Coulson Papers (hereafter CP), Bodleian Library, Oxford. MS 114, D.7.2. Letter 6 March 1951. ²CP, MS 114, D.7.2. Letter 1 October 1951. ³Coulson, British Association for the Advancement of Science Lecture, Typescript, 15.

⁴Coulson, *Science and the Idea of God*, Eddington Memorial Lecture (Cambridge: Cambridge University Press, 1958), 28–9.

⁵Coulson, *Christianity in an Age of Science*, Riddell Lecture (London: Oxford University Press, 1953), 13.

Arie Leegwater, Editor leeg@calvin.edu



This December issue of *PSCF* has articles impinging on a diverse set of disciplines: anthropology, immunology, chemistry, physics, and botany. Todd Vanden Berg (Calvin College) analyzes the habits and perspectives of Christians that have limited their participation in the field of anthropology. Craig Story (Gordon College) raises issues of randomness and complexity in the discipline of immunology. Karl Johnson and Keith Yoder, both of Cornell University, conduct an interview with Robert Fay, a member of Cornell's Department of Chemistry and Chemical Biology.

The last two articles are biographical in nature: Edward Davis (Messiah College) provides the final installment of his analysis of Arthur Compton's influential life, while Paul Fayter (York University) situates Joseph Hooker, the Victorian botanist and gentleman of science, in historical context in an essay book review.

The issue closes with a number of book reviews and three letters to the editor. Speaking of book reviews, Rebecca Flietstra (Point Loma Nazarene University) has decided to step down as one of our three book review editors. Jim Peterson and I wish to thank Rebecca for her editorial work over the past two years. We are actively searching for a new editor to begin in 2010. *

More Than You Think, but Still Not Enough: Christian Anthropologists

Todd Vanden Berg

Historically, exclusionary dynamics within the discipline of anthropology have often discouraged Christians from entering this field of study. Christians, however, by fixating on these systems of exclusion, have themselves inadvertently been oriented toward the discipline in a manner that has not only contributed to a perception of marginalization, but also ignored Christian contributions within the discipline. This article will attempt to highlight this problematic orientation and push for a reorientation of Christian views of cultural anthropology with the goal of encouraging Christians to participate in the field in significant ways.

hat are the habits and perspectives of Christians that have limited their participation in the discipline of anthropology?¹ What viewpoints have contributed to a narrow understanding of Christian scholarship within the discipline? This article moves beyond describing the exclusionary mechanisms within anthropology that have created an unfriendly atmosphere for Christians, and will instead explore the dynamics that have led to current misunderstandings. The article will also suggest changes in perspectives that will hopefully increase the numbers of Christians involved in anthropology.

Quite a few scholars have considered the relationship between anthropology and Christianity. The majority of these scholars have been Christian anthropologists. Many of them have used missionaries as proxies for Christians in order to consider the interplay between anthropology and Christianity.² This literature has clearly articulated exclusionary dynamics within anthropology toward Christians and has shown the significant negative influence on Christian involvement within anthropology. While this bias by many a-religious anthropologists toward Christianity generally, and Christian anthropologists more specifically, is clear, I believe that other factors have contributed to a perception of a small number of Christian anthropologists. These limiting factors have also prevented some Christians from becoming involved in anthropology. These factors can be witnessed through how Christians have both conceptualized and utilized anthropology.

All too often the perspective of both a-religious anthropologists and some Christian anthropologists has been that the discipline of anthropology, at its very core, is a-religious, and Christians who engage in anthropology are interlopers. While it is true that many a-religious scholars in anthropology

For the past fourteen years, **Todd Vanden Berg** has been a professor of cultural anthropology at Calvin College (Grand Rapids, MI). He completed his undergraduate degree at Calvin College and his PhD at the State University of New York at Buffalo. He did his dissertation fieldwork in Adamawa State, Nigeria, with the Longuda. Vanden Berg's research and publications have included the treatment of Longuda traditional and primal religious beliefs in the context of an involuntary resettlement project, as well as the Longuda integration of beliefs in swanba (witches) with Christianity. He has spent five January terms (interims) in Jamaica, teaching an introductory course on third-world development to Calvin students. This has led to his latest area of scholarly interest in host culture perspectives on tourism and tourists.



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have been less than friendly toward Christian anthropologists, this by no means speaks to the inherent nature of the discipline. Anthropology is the comparative study of human populations. An a-religious bias is not built into this endeavor. Those who practice anthropology, even if in the majority and at the center of power, may indeed be less than friendly to Christians in the discipline, but the discipline itself is void of this foundational orientation. The discipline of anthropology is not inherently antireligious simply because historically those in the mainstream have been so. I am aware that there are Christians-even Christians intimately involved in anthropology-who would not hold this view, but it is a view that I fervently hold and that informs the direction of this article.³ In short, I hold to a reformed perspective on matters concerning the need for or "call to" Christian engagement in the academy-specifically, anthropology. This article assumes this perspective but will not be a defense of this perspective.

Are There Few Christian Anthropologists?

Before I can outline Christian culpability for insufficient Christian involvement in anthropology, I feel compelled to scrutinize the common perception of many Christian anthropologists that there are few Christian anthropologists in the academy. An example of this opinion is the following statement by Darrell Whiteman: "Of the thousands of anthropologists, less than one percent would call themselves Christian."⁴ This is a dramatic claim echoing the perspectives of many Christian anthropologists, but it is a claim that, to my knowledge, is not empirically substantiated.

Certainly the historical tensions between a-religious anthropologists⁵ and Christians are no doubt a significant contributing factor to the view that there are few Christian anthropologists: i.e., if the discipline is unfriendly to Christians, then Christians will not only be pushed away from the discipline, but will also choose to avoid exposure to this toxic atmosphere. Exclusionary dynamics within anthropology have had significant historical negative impact on Christian involvement that continues today. The result is that some believe that anthropology is, at its core, antithetical to Christianity.

Out of this historical understanding of the antagonistic relationship between a largely a-religious discipline and Christianity, more contemporary "evidence" of this view has supported the notion that there are few Christian anthropologists. What follows are four such arguments and my response to them. It is significant to note that all of the arguments flow from Christian perceptions of anthropology. Arguments by a-religious anthropologists for a dearth of Christian anthropologists would likely be quite different. I am focusing on Christian observations because they ultimately inform Christian participation in the discipline. I will simply consider the possibility that the assumption that there are very few Christian anthropologists may indeed be false. Just as the claim for a dearth of Christian anthropologists has no substantiating data, my counterclaim also has no clear, substantiating data. In the end, data will need to be gathered to determine the true number of Christian anthropologists. Ultimately, by calling these arguments into question, I will be making a case for a new, refreshed involvement of Christians within anthropology.

Contemporary "Support" for Few Christian Anthropologists

American Enterprise Poll

The oft-cited empirical data supporting the notion of few Christians within anthropology is a survey, "Politics of the Professoriate," published in *The American Enterprise*.⁶ The survey is usually summarized along these lines: 65% of anthropologists in academic departments answered "none" when asked their religion. In other academic disciplines, 30% was the average of those who responded "none." The disparity of response to this question between anthropologists and academics in other disciplines is certainly remarkable. However, if one goes back to the survey and considers the exact question, a slightly different story emerges.

The statistics for the 1991 article were gathered from data collected by Gallup from January through December 1984. The question asked in the Gallup poll was, "What is your religious preference?"⁷ The survey question did not ask if a person was religious; rather, it asked if the person had a religious *preference*. This may sound like an all-too-fine distinction for some, but it may be significant for a culturally sensitive anthropologist. I grant that

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for many Christians, a "spiritual" but not "religious" anthropologist may look no different than an active, engaged Christian. So let us consider the survey from another angle.

Even if the survey question were to be interpreted as a respondent having no religious beliefs when answering "none," 35% of anthropologists in academic institutions polled did indeed have religious beliefs. Therefore, although the data did highlight that there are more agnostics, atheists, or a-religious people in anthropology than in any other discipline, did the survey also highlight a small number of Christian anthropologists? Consider the American Anthropological Association (AAA) in the context of this data. Although membership in the AAA does not represent all anthropologists in North America, it does serve as a good starting point for consideration. The AAA currently has a membership of just over 10,000.8 Assuming that the response of anthropologists from twenty-five years ago (1984) would be similar today, 6,500 anthropologists might be considered a-religious, while 3,500 anthropologists would affirm some religious affiliation. Also, in a North American context, one could assume that Christianity would be the religious affiliation in the majority. Unfortunately, we have no data on the nature of the religious beliefs of these people. But to tacitly assume that few of these anthropologists are Christians seems improper and is unfortunate.

Network of Christian Anthropologists

A second observation, supposedly in support of the notion that there are few Christian anthropologists, has been to cite the low number of anthropologists who attend the informal meeting of the "Network of Christian Anthropologists" at the annual AAA meeting.9 The average number of attendants is between thirty and fifty.¹⁰ The assumption of those who use this attendance to highlight the tiny number of Christian anthropologists is that all Christian anthropologists would choose to attend the informal meeting. It seems possible, however, that the low number of anthropologists attending the Network meetings simply means that few Christian anthropologists desire to attend the meetings. The attendance at the meetings cannot be inferred to be a measure of the number of Christian anthropologists.

There seem to be three possible explanations for this lack of attendance. First, the small number of

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anthropologists at the meeting parallels the small number of Christians in anthropology. I do not support this possibility. The second and third explanations both support the possibility of larger numbers of Christian anthropologists. The second is that, for fear of being labeled as a Christian in the academy, many Christian anthropologists choose not to attend. This explanation seems entirely possible and would reflect the historical tensions between a-religious and Christian anthropologists. The third possible explanation could be that many Christian anthropologists perceive the meeting to focus on issues of little interest to them and so choose not to attend. I will get back to what this perception might be later in the article.¹¹

Few Applicants for CCCU Anthropology Positions

A third contention I have heard (and even used myself in the past) that seems to support the notion that there are few Christian anthropologists, involves the difficulty of compiling a suitable list of potential anthropology hires in institutions within the Coalition of Christian Colleges and Universities (CCCU). For some, this difficulty comports with the belief that there are few Christians in anthropology. A lack of applicants, however, only informs us that a small cohort of Christian anthropologists is interested in applying for positions at Christian undergraduate institutions; it does not more generally tell us that there are few Christian anthropologists. A possible explanation for the small pool of applicants for such positions relates to the third option in the previous argument, in that it also concerns perceptions of what interests Christian anthropologists. Again, I will consider this perception in more depth in a moment.

Lack of Impact on the Discipline

A fourth consideration that supposedly supports the idea that there are few Christian anthropologists argues that Christian anthropologists have not impacted the discipline in significant ways. Dean Arnold states that there "has been relatively little scholarship by Christian anthropologists directed to the academy."¹² What does Arnold mean when he speaks about "Christian scholarship" "directed to the academy"? Does he mean *explicit* Christian scholarship that has theoretically impacted the discipline, or Christian scholarship that undermines a-religious biases against Christian anthropologists? This leads me to posit two questions relating to

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Christians and scholarship: (1) Who are Christian anthropologists? and (2) What does Christian anthropological scholarship look like? Answering these questions may give another perspective on just how many Christian anthropologists are in the academy.

Who Is a Christian Anthropologist?

The anthropological component of the description "Christian anthropologist" can be easily defined: a degree (undergraduate/graduate) in anthropology. The other side of the description is more difficult to define and, to my mind, this has been problematic in Christian anthropological circles. In a North American context that is permeated by Christian influences, a separation between "nominal" and "devout" Christian could and indeed should be made. In this context, a series of twelve questions used by Gallup and Timothy Jones distinguishes "heroic and faithful" Christians from nominal Christians.13 The intention of identifying heroic and faithful Christians is to more accurately differentiate the engaged Christian from the nominal Christian. Such an assessment would be useful in the context of this article but, to my knowledge, has not been applied to those who consider themselves to be Christians and are anthropologists. How the cohort of the 35% of anthropologists in the academy who have a religious preference in the "Politics of the Professoriate" article breaks down into these categories, is not clear from the data. We do not know the specific religious affiliation of this 35% or the strength of their religious beliefs and commitments. Such data need to be gathered in order to add to an understanding of Christians involved in anthropology. I fear, however, that it is often assumed within anthropological circles of the CCCU that the numbers are very small.

Without any clear descriptive data available, there have been two common and unfortunate approaches used to take a head count of Christian anthropologists. First, apply the description "Christian anthropologist" to those anthropologists who work at Christian institutions. Now, if this were the only place where Christian anthropologists were to follow their vocation, then it certainly would be true that there are few Christian anthropologists. Of the 105 institutions in the CCCU, there are only approximately thirty full-time anthropologists in undergraduate faculty positions. But how many Christian anthropologists are employed at institutions other than those affiliated with the CCCU? Or, to repeat, how many of the 35% who claim a religious preference in the "Politics of the Professoriate" article could be described as "devout" or "heroic" Christians? Again, we do not know.

The second approach commonly used to "count" Christian anthropologists is to apply the description to those anthropologists whose scholarship is *explicitly* Christian. Let us now consider the issue of Christian anthropological scholarship.

What Does Christian Anthropological Scholarship Look Like?

Nicholas Wolterstorff argues that some neo-Calvinists have it wrong when assuming that Christian scholarship will necessarily be different from non-Christian scholarship. Wolterstorff underscores the need to understand Christian scholarship through the lens of "faithfulness," stating that "Christian learning [scholarship] is learning practiced in fidelity to the gospel."14 Faithfulness is the unique characteristic of Christian scholarship. Difference from non-Christian scholarship is not a condition of Christian scholarship (although it may be a consequence of faithful scholarship). Wolterstorff's insights are helpful when considering the implicit and explicit nature of Christian scholarship.¹⁵ The assumption of a polemic between Christian and non-Christian scholarship serves to prevent one from seeing "faithful" Christian scholarship and may serve to blind one to the Christian scholarship done in secular anthropology departments.¹⁶

In "The Elusive Idea of Christian Scholarship," Michael Hamilton argues that Christians often do not view the notion of Christian scholarship in broad enough terms, and that the idea of "scholarship of discovery" often falls outside the boundary of Christian scholarship in Christian evangelical institutions. Hamilton states:

We also operate with a surprisingly narrow definition of what constitutes scholarship. I have found that people usually think that the term means scholarship that is explicitly Christian and distinctively Christian. They almost always believe that it must somehow look different than secular scholarship. The result of this narrow definition of Christian scholarship is that we have built a wall of separation between Christian scholarship and research scholarship in the mainstream academic disciplines.¹⁷

The implicit nature of some forms of Christian scholarship is that God-honoring Christian scholarship may look no different than any other scholarship. What *motivates* the scholarship may be very different, however. A result of this is a schism between anthropologists who do explicitly Christian scholarship and/or work in Christian institutions, and those Christian anthropologists who do implicitly Christian scholarship and/or work in secular institutions.

Anthropology in the CCCU

We have explored possible explanations as to why so few Christian anthropologists attend the informal meeting of Christian anthropologists, why applicant pools for CCCU anthropology positions are shallow, and why there is a perception that Christian anthropologists have little impact on scholarship. I have exposed an unhealthy and narrow understanding of who might be a "Christian anthropologist" and what "Christian scholarship" might look like, and I have outlined my assumption that there may be more Christian anthropologists than previously believed. In the remainder of this article, I will argue how growth in the numbers of Christian anthropologists has been hindered at CCCU institutions.

This narrow understanding of what defines a Christian anthropologist has had a substantially negative influence on Christian undergraduate institutional commitment to anthropology. A feedback loop of sorts has served to perpetuate this unhealthy dynamic at CCCU institutions. It is to this issue that I now turn. Let us first look at the data, and then I will make my argument. What follows is a brief overview of how anthropology has been utilized at CCCU institutions.

The AAA data shows a significant growth in undergraduate anthropology majors in the USA over the last few decades. In 1966, there were 1,250 BA degrees granted in anthropology. In 1986, 3,490 degrees were granted. In 2006, 10,863 anthropology BAs were granted.¹⁸ This growth has not been paralleled at CCCU institutions. Of the 105 institutions in the CCCU, only five institutions have what can be considered stand-alone anthropology majors: Biola University, Eastern University, Lee University, Vanguard University, and Wheaton College.¹⁹ Compare this statistic to data compiled from the top twenty-five undergraduate schools in the 2007 *U.S. News and World Report* rankings of the best liberal arts colleges.²⁰ The average undergraduate population in the top twenty-five schools is 1,903 compared to 2,857 in the CCCU. Of these top twenty-five schools, twenty-three have an anthropology major.²¹ The contrast between these two groups of schools is substantial and dramatic.

Concerning the number of faculty per institution, excluding instructors, visiting professors, and emeriti, the average number of anthropology professors employed at the top twenty-five liberal arts institutions approaches five (4.8). As for anthropology faculty in CCCU institutions, I have compiled a working list of full-time anthropologists employed at the 105 CCCU institutions (www.calvin.edu/go/ anthrodir). At the time of publication, thirteen institutions employ full-time tenure-track anthropologists: Bethel University (2), Biola University (6), California Baptist University (1), Calvin College (2), Eastern University (3), Houghton College (1), Lee University (2), Messiah College (1), Oklahoma Baptist University (2), Seattle Pacific University (1), Vanguard University (3), Westmont College (1), and Wheaton College (2). The total number of full-time tenure-track anthropologists at these institutions is twenty-seven. The average number of anthropologists per institution at CCCU institutions is 0.26. These disparate figures of anthropology major programs and faculty are sobering and merit explanation. The data suggest that when it comes to anthropology, there is an unfriendly or unwelcoming environment at CCCU institutions.

Beyond Historical Factors— The Hindrance of Missions and an Anthropological Tool Kit

Now it is certainly true that historical dynamics have had a negative impact on Christians participating in anthropology. They may also have served to keep Christians who otherwise would be interested in anthropology from becoming anthropologists. At the same time, they may have predisposed others to think of anthropology in negative terms, for example, as an a-religious, relativistic discipline. These may well be significant factors that have hindered the growth of anthropology programs at CCCU institutions.

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Such a perception of anthropology I have personally witnessed. In the summer before I came to Calvin College to teach cultural anthropology, I was mowing my lawn when a fellow Calvin College professor and neighbor came walking by. He greeted me, welcomed me to the neighborhood, and, knowing my new position at Calvin, proceeded to ask me if it were not oxymoronic to be a Christian anthropologist. Uncomfortably, I smiled and laughed with him at his witty comment-becoming painfully aware that Christian anthropologists are often in uncomfortable relations not only with a-religious anthropologists but also with Christian colleagues. Charles Kraft makes a similar observation in Anthropology for Christian Witness.²² Christian anthropologists frequently hear such comments. Without doubt, there are those Christians who believe that the discipline of anthropology is antithetical to Christianity. This may well be a limiting factor in the growth of anthropology programs at CCCU institutions.

However, I believe that a lack of anthropology programs at CCCU institutions can be explained by another factor. Ironically, part of the culpability lies with those Christians who were often the first to become involved in anthropology – Christians who have pushed for the use of anthropological perspectives in explicitly Christian contexts – historically, Christians involved in missions.²³ For such Christians, anthropology is often not valued as a discipline, but rather it is valued for a certain set of tools or perspectives. This viewpoint is problematic, and the results are manifested in a number of ways.

A narrow perception of who Christian anthropologists are and what they do connects directly to the historical relationship between anthropology and missions. Anthropologists have historically been closely tied to mission efforts,²⁴ and this association has left a significant and negative impact on Christian perspectives of anthropology in two significant ways.

The first of these has influenced perspectives on what Christian anthropologists do. This early form of applied anthropology at Christian institutions has contributed to the skewing of anthropology toward a stress on anthropology as a missions vocation. As frequently happens, some Christians who have gone on to receive PhDs in anthropology have done so because they see anthropology as a tool—a tool by which one can be a more effective, culturally nuanced missionary.²⁵ They often either return to the mission field, or continue in missions via teaching anthropological perspectives to those who aspire to go into missions. Brian Howell states,

Anthropology has found a peculiar niche in evangelicalism among the missions departments of seminaries. A number of gifted anthropologists hold these important posts, yet struggle against a perception that their role is primarily in training—preparing the troops for the field.²⁶

The scandal of the evangelical mind appears to apply in a unique way to anthropology.²⁷

Further, because many Christian voices in anthropology have come out of a missiological context, students of anthropology who are Christian see Christian scholarship in anthropology almost exclusively from a missiological perspective. For example, Eugene Nida's classic text, *Customs and Cultures*, begins by stating, "Good missionaries have always been good anthropologists."²⁸ Charles Kraft's *Anthropology for Christian Witness* elaborates on the theme:

One of our major aims in this approach to the study of anthropology is to learn to protect the people of other societies from our own inclination to make them like us. It is a sad fact that, though Paul learned from the Holy Spirit to be a Jew to Jews and a Gentile to Gentiles, many of today's cross-cultural witnesses have not learned that approach. We pray that the Holy Spirit will use anthropological insight in our day to show us how we are to go about adapting ourselves and our presentation of the message of God to those immersed in other cultures.²⁹

While anthropological insights are an important element in the understanding of missions, I fear that this is the dominant way in which Christian undergraduates are exposed to anthropology. As Dean Arnold states,

Christian anthropologists ... tend to see their scholarship through American cultural glasses. This perspective emphasizes pragmatism and utility ... and focuses on the traditional mission of the church ... [It] fails to see scholarship as a stewardship of one's mind, and as an activity that simply brings glory to God regardless of its utility.³⁰

Todd Vanden Berg

Christians who believe anthropology to be antithetical to Christianity exacerbate the situation. If this is the overwhelming perception of anthropology, then it is understandable why these Christians do not want to support wholehearted involvement in the discipline, and why they may well be inclined to use the tools, approaches, or strengths of the discipline for non-anthropological ends.

A second negative impact of the historical tie between anthropology and missions in Christian circles relates to how Christian institutions have utilized and promoted anthropology. The strong historical tie between anthropology and missions has ultimately hindered the growth of Christian anthropology by unintentionally, but nonetheless significantly, limiting the growth of anthropology programs at CCCU institutions. Interestingly, it is common for Christian anthropologists to critique a-religious anthropological biases against Christianity by focusing specifically on the treatment of Christian missionaries, inadvertently supporting the notion that Christian anthropology *is* missions.

I can relate anecdotally my personal graduate school biases, as well as opinions that were widely held in graduate school, on the relationship between anthropology and missions. I relate the following confessionally: While preparing to do fieldwork for my PhD in Adamawa State, Nigeria, I struggled with how people would perceive my work. The Christian Reformed Church in which I had been raised has a long history of sending missionaries to Nigeria, and I felt that I would invariably be associated with doing missionary work. Although I was clearly in graduate school to receive a PhD in anthropology and obviously not in seminary, I feared others would assume that my anthropology degree was simply a stepping-stone to the mission field. My fears were confirmed on more than one occasion. For example, upon informing an acquaintance that I was getting a PhD in cultural anthropology and was about to do fieldwork in Nigeria, I was asked what mission work I would be doing. At the time I thought such a question was based on geography-Nigeria. I assumed that people from my church denomination associated Nigeria with missions, but I now believe the question was based equally on Christian perspectives on anthropology. It seems that if a person is a Christian and an anthropologist, then, for many Christians, he or she must also be a missionary. My "fears" and my acquaintance's question both support the assumption of a connection between anthropology and missions.

I believe that students at CCCU institutions are not consistently taught to think of anthropology as a valid self-contained discipline within which to pursue faithful Christian scholarship. Because of this bias, few Christians initially pursue anthropology for the sake of anthropology. There seems to be a significant break between those who see anthropology as a set of perspectives and those who see it as a primary arena for Christian scholarship—the latter being clearly in the minority.

I suspect that many Christian anthropologists do not attend the informal meetings at the AAA annual meetings because of this understandable but misplaced perspective. They may perceive those attending the meetings as being interested in missiological issues. This bias informs me that somewhere along the line many people have come to feel that Christians who are anthropologists, more often than not, are involved in missiology. Dean Arnold has noted that the initial meetings were indeed focused on anthropological issues relating to missions.³¹ I also suspect this bias explains why CCCU anthropology positions are hard to fill. Christian anthropologists at CCCU institutions are commonly and narrowly associated with missionaries. Anthropology is understood, often accurately, to be a service discipline to other major programs or to wider college agendas such as increased global sensitivity or cross-cultural engagement. For some Christian anthropologists, this is not how they feel called to serve in the discipline. Using anthropology exclusively for the furtherance of missions or of wider college goals (e.g., cross-cultural engagement) limits the breadth of possibilities that Christians can have in pursuing Christian scholarship in anthropology.³²

Apply a reductionist approach to anthropology and you are left with only a grab bag tool kit: cultural relativism, concept of culture, importance of historical context, holistic approach in time, space, content, and so forth. You are left with nothing but secondary or latent functions of the discipline of anthropology. The discipline itself is left void, hollow, and with no intrinsic value. The paltry number of anthropology programs at CCCU institutions reveals this to be the case. This approach toward anthropology at CCCU institutions has negatively impacted the number of Christians involved

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in anthropology as well as the diversity of that involvement.

How do we as Christian scholars correct this problem? First, and I am sad to have to say this, Christians need to know that anthropology is not anti-Christian. Some anthropologists may be, but the discipline is not. Second, as a cohort, CCCU member institutions need to develop anthropology major programs. Anthropology can never be an equal player if sociology departments subsume it. I say "as a cohort" because institutional size, financial constraints, and other limitations prohibit many or most CCCU institutions from developing majors in anthropology. Third, Christian anthropologists with missiological backgrounds who teach at CCCU institutions need to consciously seek to widen their students' understanding of the diversity of Christian scholarship within anthropology. Fourth, beyond anthropology and following Wolterstorff and Hamilton, CCCU institutions need to underscore the breadth of Christian scholarship possible for its faculty. Fifth, following the preceding recommendations, would-be Christian anthropologists need to be trained to exert an influence on anthropology well beyond the boundaries of CCCU institutions.³³

Christians, I believe, need to make a concerted effort to improve the possibility for growth of Christian scholarship in anthropology. The trajectory of anthropology in the CCCU is not encouraging. Few Christian institutions have witnessed a growth in anthropology on a par with the growth of anthropology at secular institutions. CCCU institutions should continue to use the discipline of anthropology to prepare students to be effective, informed, and sensitive Kingdom workers in broad terms including training Christians to be influential scholars in the discipline of anthropology.

If we can accept that Christian anthropologists are found in significant numbers at secular institutions, then we can also accept that such scholars are doing Christian anthropology. If this occurs, not only does the discipline look less unfriendly (there are Christian anthropologists at secular institutions), but the interaction between Christian anthropologists doing implicit or explicit scholarship is possible. If CCCU institutions expand their understanding of anthropology beyond a service discipline and begin to develop stand-alone major programs, then even more Christians will pursue anthropology as a sphere of faithful service to God. 34

Acknowledgment

I am grateful to Calvin College for making it possible for me to pursue this topic, by means of a sabbatical as well as a Deur Award.

Notes

¹This article will focus on the sub-discipline of cultural anthropology rather than on the entire discipline.

²Roland Bonsen, Hans Marks, and Jelle Miedema, eds., The Ambiguity of Rapprochement: Reflections of Anthropologists on Their Controversial Relationship with Missionaries (Nijmegen: Focaal, 1990); Ernest Brandewie, "Ethnology and Missionaries: The Case of the Anthropos Institute and Wilhelm Schmidt," in Missionaries, Anthropologists, and Cultural Change: Studies in Third World Societies 25, ed. Darrell Whiteman (Williamsburg, VA: College of William and Mary, 1983), 369-86; Robert Priest, "Anthropologists and Missionaries: Moral Roots of Conflict," in Current Concerns of Anthropologists and Missionaries, ed. K. J. Franklin (Dallas, TX: The International Museum of Cultures, 1987), 35; Robert Priest, "Missionary Positions: Christian, Modernist, Postmodernist," Current Anthropology 42, no. 1 (2001): 29-68; Frank Salamone, "Anthropologists and Missionaries: Competition or Reciprocity?" Human Organization 36 (1977): 407-12; Frank Salamone, "Epistemological Implications of Fieldwork and Their Consequences," American Anthropologist 54, no. 81 (1979): 46-60; Claude Stipe, "Anthropologists Versus Missionaries: The Influence of Presuppositions," Current Anthropology 21 (1980): 165-8; Frank Salamone, ed., "Missionaries and Anthropologists," in Studies in Third World Societies 26 (Williamsburg, VA: College of William and Mary, 1985); George Stocking Jr., The Ethnographer's Magic (Madison, WI: University of Wisconsin Press, 1992); Vinson Sutlive Jr., "Anthropologists and Missionaries: Eternal Enemies or Colleagues in Disguise?" in Missionaries, Anthropologists, and Cultural Change, 55-90; Sjaak van der Geest, "Anthropologists and Missionaries: Brothers under the Skin," *Man, New Series* 25, no. 4 (Dec. 1990); Sjaak van der Geest, "Missionaries," in *Encyclo*pedia of Cultural Anthropology 3, ed. D. Levinson and M. Ember (New York: Holt, Rinehart, 1996), 797-800; Darrell Whiteman, "One Significant Solution: How Anthropology Became the Number One Study for Evangelical Missionaries. Part I: Anthropology and Mission: The Incarnational Connection," International Journal of Frontier Missions 20, no. 4 (Winter 2003): 34-44.

³See Jenell Williams Paris, "A Pietist Perspective on Love and Learning in Cultural Anthropology," *Christian Scholar's Review* 35, no. 3 (Spring 2006): 371–85; and Todd Vanden Berg, "A Reflection on Jenell Williams Paris's 'A Pietist Perspective on Love and Learning in Cultural Anthropology," *Christian Scholar's Review* 35, no. 3 (Spring 2006): 387–93.

⁴Darrell Whiteman, "One Significant Solution: How Anthropology Became the Number One Study for Evangelical Missionaries. Part II: Anthropology and Mission: The

Incarnational Connection," *International Journal of Frontier Missions* 21, no. 2 (Summer 2004): 81.

⁵I need to acknowledge that a-religious anthropologists do not hold a monolithic opinion of Christians.

⁶Although the data is twenty-five years old, this survey continues to be cited in recent publications. "Politics of the Professoriate," *The American Enterprise* (July/August 1991): 86–7.

⁷Responses were coded with the following options: Protestant (includes Baptists, Christian Church, Episcopal, Jehovah Witness, Lutheran, Methodist, Presbyterian, etc.), Roman Catholic, Jewish, Orthodox Church, Mormon (include the Church of Jesus Christ of Latter-Day Saints), Muslim, Hindu, Other, None, and Undesignated.

⁸www.aaanet.org/history.htm

⁹Dean Arnold, "Why Are There So Few Christian Anthropologists? Reflections on the Tensions between Christianity and Anthropology," *Perspectives on Science and Christian Faith* 58, no. 4 (2006): 266–82.

¹⁰Ibid., 268.

¹¹A reviewer of this manuscript added that a fourth possibility could be competing events that may be deemed to be more important for personal and/or professional reasons.
¹²Dean Arnold, "Why Are There So Few Christian Anthro-

pologists?" 267.

¹³See Ronald J. Sider, *The Scandal of the Evangelical Conscience: Why Are Christians Living Just Like the Rest of the World?* (Grand Rapids, MI: Baker Book House, 2005); John G. Stackhouse Jr., "What Scandal? Whose Conscience?" *Books and Culture: A Christian Review* (July/August 2007): 20–1, 41–2.

¹⁴Nicholas Wolterstorff, "On Christian Learning," in *Stained Glass: Worldviews and Social Science*, ed. Paul Marshall, Sander Griffioen, and Richard Mouw (Lanham, MD: University Press of America, 1989), 57–80.

¹⁵See also Wolterstorff's understanding of "control beliefs" in Nicholas Wolterstorff, *Reason within the Bounds of Religion* (Grand Rapids, MI: Eerdmans, 1978).

¹⁶For example, the work of E. E. Evans-Pritchard, Victor Turner, and Mary Douglas could be discussed in this context.

¹⁷Michael S. Hamilton, "The Elusive Idea of Christian Scholarship," *Christian Scholar's Review* 31, no. 1 (2001): 16.

¹⁸Data provided by the AAA.

¹⁹Eastern University has a missions and anthropology major. I would not be inclined to consider this major as a "stand alone" anthropology program save for the fact that Eastern offers fully eleven anthropology courses. A similar dynamic holds for Bethel University—it offers a blended anthropology and sociology major. One could argue for or against the notion that Bethel University has enough anthropology courses to be considered a "stand alone" anthropology major—I would say no.

²⁰http://colleges.usnews.rankingsandreviews.com/usnews/ edu/college/rankings/brief/t1libartco_brief.php

(accessed May 2008).

²¹Six of these schools have a joint sociology and anthropology major but have sufficient anthropology courses to be considered legitimate majors. Of the two schools that do not have anthropology majors, Harvey Mudd College focuses on math, science, and engineering while Claremont McKenna College stresses business and public affairs. ²²Charles Kraft, *Anthropology for Christian Witness* (New York: Orbis Books, 1996), 2.

²³The stress on using anthropology for missions has a more contemporary compatriot—International Development Studies. At Calvin College, both cultural anthropologists are involved in the International Development Studies Major.

²⁴Darrell Whiteman, "One Significant Solution: Part I."

²⁵Empirical data need to be gathered here to support or deny this claim. I am interested, for example, to know how many PhDs in anthropology who teach at CCCU institutions have ties to missions.

²⁶Brian Howell, "The Anthropology of Christianity: Beyond Missions and Conversion – A Review Essay," *Christian Scholar's Review* 34, no. 3 (Spring 2005): 354.

²⁷A theme of Noll's book considers an evangelical Christian's disinterest in the life of the mind. Mark Noll, *The Scandal of the Evangelical Mind* (Grand Rapids, MI: Wm. B. Eerdmans, 1994).

²⁸Eugene A. Nida, *Customs and Cultures* (Pasadena, CA: William Carey Library, 1975).

²⁹Charles H. Kraft, *Anthropology for Christian Witness* (New York: Orbis Books, 1996), 2. In response to this quote, I would add that anthropological insights might also be used by Christians in the West to accept the forms of Christianity that are emerging in other parts of the world independently of Western influences – influences that might come either from Western missionaries or indigenous leaders who are Western educated. The challenge for many in the West is to understand that Christianity on a global scale is no longer European in nature. The reflexive nature of anthropology should allow for such cultural self-awareness.

³⁰Dean Arnold, "Why Are There So Few Christian Anthropologists?" 278.

³¹Ibid., 267.

³²I want to say that I am ever thankful to Calvin College for allowing me the freedom to pursue my calling and my interest in anthropology in the ways that I have seen fit.

³³My graduate school experience tells me that there are more sincere Christians involved in anthropology at secular institutions than one would believe to be the case, especially considering the historical animosity of a-religious anthropologists toward Christians. An interesting arena of research would be to set out the character of Christian scholarship in anthropology for Christians within secular as well as at evangelical institutions.

³⁴I acknowledge that CCCU institutions are not the only institutions where Christians can pursue anthropology.



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The God of Christianity and the G.O.D. of Immunology: Chance, Complexity, and God's Action in Nature



Craig M. Story

Craig M. Story

Many people of faith have difficulty with the idea that randomness can exist in nature; randomness is viewed as directly conflicting with God's sovereignty. Biological processes often rely on randomness to achieve important ends. The example of antibody gene rearrangement is discussed as a primary example of such processes, and the ways God can be understood to be acting in the face of apparently random processes are explored.

uch of the tension that exists between science and certain groups within the Christian faith, particularly in the United States, arises from the complete rejection by many Christians of the possibility that randomness could exist in a world created and sustained by the sovereign, all-knowing, and all-powerful God of the Scriptures. Yet, as any geneticist will tell you, random mutations provide the source of variation in populations of organisms, which are the raw material of evolution. Still, the average person on the street will find it highly counterintuitive that something orderly and purposeful can arise through a random process. For example, author Lee Strobel, in his popular book *The Case for a Creator:* A Journalist Investigates Scientific Evidence That Points toward God, rejects naturalism because he is not able to believe that "randomness produces fine-tuning" and "chaos produces information."¹ Strobel here represents a mainstream group of believers who have trouble reconciling two ideas: (1) the seemingly random

behavior of atoms and molecules in nature, and (2) God's upholding of the universe, his foreknowledge and sovereign control over events. I believe that natural systems are characterized by a kind of randomness that is a critical aspect of the way the world operates.

In this article, I define biological randomness more precisely as extreme unpredictability, and I discuss various ways of understanding the concept of randomness. I argue that randomness does not necessarily exclude purpose. In fact, such unpredictability is a necessary feature of many biological systems; it is randomness with a purpose. People whose conception of God allows for no such randomness are forced either to reject their God, or, more likely, ignore

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these observations of the natural world. I believe that this is a false choice based on a flawed understanding of God's action in the world.

A major goal of this article is to clearly demonstrate how a specific type of randomness is an essential component of some biological systems, and is compatible with belief in the biblical God of traditional Christianity. An example from my own field of immunology is the process whereby antibody gene segments rearrange to form functional genes, which I will describe below in some detail. This is just one example that illustrates how extensive and multilayered biological examples of randomness can be. In contradiction to Strobel's statement and many people's intuition, randomness, in this case, does, in fact, "produce fine-tuning." As one who upholds my college's statement of faith in "one God, the Creator and Sustainer of all things," I personally believe that randomness is compatible with God's sustaining and creative activity. The final section of this article will discuss philosophical ways to understand how God's activity relates to this kind of randomness in the natural realm.

Definitions of Randomness

It is important to define terms from the outset, since the words "random" and "chance" can have different meanings, depending on the context, and are used interchangeably by some authors, but not by others. The term "randomness" can have a precise mathematical meaning, as well as more common, intuitive meanings. The topic of randomness has come up a number of times in Perspectives on Science and Christian Faith (PSCF). I refer the reader to Ronald Remmel's presentation before the California State Board of Education in 1972, reprinted in this journal,² in which he discussed several possible interpretations of the word, and discussed some of the quantum mechanical aspects of the issue, which are beyond the scope of the current discussion. In his speech, Remmel asked the important question of whether the world is really random or only appears that way to our limited knowledge. His personal belief was that God determines the random numbers that make the world function.

In a more recent paper, G. R. Morton and G. Simons discussed the issue of biology and chance, with respect to genome organization.³ They point out that the Bible repeatedly describes God as being in con-

trol of chance mechanisms (such as casting lots). These authors distinguish between some meanings of randomness and chance. For instance, one definition of a random process that most people would understand is one in which the results of a procedure fall into a particular well-defined probability distribution. A well-balanced coin will yield a normal distribution with 50% heads and 50% tails, for example. A stochastic mechanism such as rolling dice may not be truly mathematically random, as would be the case if they were unbalanced. Nonetheless, even with a loaded die, the chance of rolling any given number is predictable with a certain defined degree of probability specific to that particular die. Likewise, card players can tell what the probabilities of various types of hands would be.

In my experience, when biologists describe a process as random, they usually mean that the process or result is exceedingly unpredictable. It is this kind of randomness that undergirds evolutionary processes such as gene duplication and genetic mutation. Since our genomes contain three billion nucleotides and tens of thousands of genes, the chance of a mutation occurring at any single point is a highly improbable event. It would seem impossible to predict, in advance, where such a singular mutational event would occur because of the improbability of a mutation occurring, since the mutation-generating enzyme (DNA polymerase) is extremely accurate and only very rarely makes a base mismatch during DNA replication. As Graeme Finlay summarized in a 2008 PSCF article on God's creative activity and randomness of DNA mutational events,

Physical laws that describe the behavior of DNA and the way it mutates (no matter how probabilistic their operation may be) are laws that reflect God's faithful dealings with his creation. ...

The operation of random (probabilistic) processes in gene and species formation cannot be an alternative to divine creativity, but is an aspect of divine creativity. Indeed, because of their evident role in contributing to the formation of new genes, such random processes (chance) in the context of the directing effects of selection (necessity) lead to predictable results.⁴

Finlay then compares such systems to powerful computer programs that use "genetic algorithms" to select optimum solutions from randomly generated choices.

It is quite likely that the antibody gene shuffling processes described below are not actually random in the mathematical sense, since some rearrangements may occur more than others. In fact, the shuffling of antibody gene segments should be seen as a very complex stochastic system whose final result, the three-dimensional shape of the final antigenbinding site, cannot be predicted in advance. Not only is the particular amino acid sequence of the resulting protein not determined in advance, but also the precise three-dimensional folded structure of the final antibody is itself highly unpredictable, and beyond the capabilities of today's most advanced computers to predict. Christians should work to understand what biologists mean when they speak of events as being random, and accept that these do, in fact, occur every day in our bodies. The more challenging philosophical issue remains, to determine what role God plays in these events. A number of different viewpoints held by theologians and other Christian writers will be discussed in the final section of this article.

Antibody Gene Rearrangement

To some it seems obvious that chance events are incompatible with God's sovereignty and omnipotence. Phillip Johnson, a key player in the intelligent design movement, has been quoted as saying that the important question about evolution is "whether there's an intelligence and purpose behind our existence-or our existence is random and accidental."5 Here, the word random and accidental are conjoined and therefore stated as having no purpose. How can God be truly in control of the world if randomness exists and accidents happen? In the following example, we will see that the system for generating antibodies involves a number of distinct steps, each of which is highly "accidental" or random in nature, yet I hope to demonstrate that it is this very randomness which provides the defense against disease that keeps new viruses and bacteria from invading our bodies.

In the antibody gene rearrangement system, widely separated segments of DNA join together in unpredictable ways, forming functional genes capable of producing antibody proteins that bind to the surfaces of invading pathogens. The great diversity of potential pathogens in the world demands that our bodies contain an equally diverse pool of antibodies to combat them. Yet, rather than encoding tens of thousands of different antibodies of predetermined binding specificity in our genome, the antibody-producing cells rearrange several antibody gene segments to produce in the range of 10⁹ different antibodies. The raw material here is a collection of hundreds, rather than thousands, of gene segments. The result is a sufficiently diverse pool of antibodies such that, at any given moment, at least a few of them are capable of binding to and inactivating any bacterium or virus encountered.

Though I have provided enough detail below to entertain a senior biology undergraduate or possibly also a biologist in a field outside of immunology, I encourage those readers unfamiliar with immunology to feel free to skim through some of the immunological details and history below, once the main point being made on how the genes rearrange is understood.

The G.O.D. of Immunology

The vertebrate immune system can produce an extremely large number of structurally distinct proteins known as antibodies, which are distinguished by the antigen they recognize. Like all proteins, they require assembly instructions encoded in the DNA. Antibodies are produced in response to a triggering substance, an antigen. The problem that plagued scientists was that there seemed to be far too many types of antibodies produced by the immune system. The number of antibody specificities is exceedingly large. This would require either a huge amount of genome devoted to antibody genes, or a diversity generation mechanism. In fact, a diversity generating mechanism does exist, and it involves several highly unpredictable (random) steps, which, in combination, greatly raise the diversity of the antibody specificity pool. Exactly how this antibody diversity is encoded in the DNA has been ironically called immunology's G.O.D. problem - and searching for the Generator of Diversity (G.O.D.) was a central mystery in immunology for many decades.

The chief job of an antibody is to bind tightly to and inactivate, or mark for destruction, foreign substances that enter the body. The ability of these antibody proteins to bind to the surfaces of viruses or bacteria that have never before been encountered, is critically important for survival. A defensive army of blood cells, called B cells, secrete antibody proteins into body fluids such as blood, lymph, and

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milk, and also into the intestine. People who lack B cells due to a genetic disorder or medical treatments such as chemotherapy become repeatedly afflicted by bacterial, viral, and fungal infections that a normal person would fight off easily.

Antibodies are arguably among the most important proteins for immune defense. These Y-shaped proteins mysteriously and suddenly (within a week) appear in the blood following exposure to a foreign substance. This foreign substance could be the protein or sugar antigens contained in a vaccine (a flu shot), or the actual pathogen itself (influenza virus). Long before it was known how these specific antibodies were produced, it was understood that a vaccine could provide long-lasting protection from disease, if it contained antigens similar to those of a pathogen and was delivered in a weakened or non-infective form. For simplicity, the following discussion will focus on the antibody diversity generation mechanism. However, a parallel (homologous) G.O.D. system is found in the T cell arm of the immune system for the generation of T cell receptors.

The search for mechanisms used by the body to produce such a diverse immune repertoire began with Paul Ehrlich around 1900. The problem was amplified after Karl Landsteiner's demonstration that laboratory animals could produce antibodies against man-made organic compounds not found in the natural environment (experimental work around 1917, discussed in Tauber⁶). Starting in the 1970s, using the tools provided by the recombinant DNA revolution, the solution to this puzzle of antibody diversity has been revealed in great detail.

The diversity generating mechanism is summarized in the following, and provides a clear example of a kind of randomness that is often observed in biological systems. Lennox and Cohn coined the phrase "generator of diversity" (and the catchy abbreviation G.O.D.) to describe the process whereby antibodies obtained their diversity. The portion of their 1967 review in which G.O.D. is first mentioned is shown below, and despite the use of some terms unfamiliar to the non-immunologist (v for variable gene region, c for constant gene region), it should be apparent that, at the time, they did not have much to go on in formulating a mechanistic explanation. These authors were trying to explain the observation that antibodies have portions of their sequences that are very consistent (constant) from one to another antibody, and other regions that are highly different in amino acid sequence (variable). The DNA encoding these segments has a very defined region wherein the variability is found. This variable region, we now realize, is the part of the antibody that binds antigen, and the source of this variableness is what Lennox and Cohn were speculating about in their review.

One can imagine models in which variety is introduced into v, not c. An example is that proposed by Brenner & Milstein. Whatever the detailed mechanism, one must suppose a region in DNA which signals the start or stop for the generator of diversity. This is abbreviated GOD ... Diversity could be generated by an error-prone DNA polymerase or an error-prone DNA template. Included must be a mechanism to assure that the portion of the v gene coding for V in the protein is varied throughout its length, i.e., there must be a stop as well as a start signal. The reason for assuming this is the failure to find a gradient of variability along V ... A mechanism which introduces random variation in V must waste chains and, therefore, cells since not all amino acid residues introduced into V are compatible with a functional subunit. Controlled variation would eliminate waste, but no simple mechanism for this, consistent with the facts we are trying to explain, presents itself.7

The point that Lennox and Cohn were making was that they suspected that the region of DNA encoding the variable, antigen-binding portions of the antibody gene was produced by an error-generating mechanism that was targeted to a part of the DNA. Here, "error" is a necessary aspect of the production of antibodies. Such errors were seen at the time as a necessary feature driving the diversity of the antibody population. Lennox and Cohn's speculations were partly correct, as we will see below.

Competing Theories to Explain Antibody Diversity and Specificity

For the first half of the twentieth century, prior to the discovery of T lymphocytes, the field of immunology focused heavily on theories of antibody formation. In addition to the diversity problem, scientists were also puzzled by the basis for self-nonself discrimination – stated another way, this is the immune system's nonreactivity to its own antigens (selftolerance). We not only need a diverse pool of antibody specificities, but we also need to avoid selfreactivity; the antibodies we produce must be directed against pathogens or foreign antigens, and not against self antigens. When the immune system produces antibodies against its own tissues, the result is autoimmune disease, something immunologist Paul Ehrlich appropriately termed *horror autotoxicus.*⁸ Examples of common autoimmune diseases include rheumatoid arthritis, lupus, and type I diabetes. In each case, the immune defenses are directed against normal body tissues.

Understanding the physiological basis for selfnonself discrimination and antigenic specificity was helped along by a short paper published in the littleknown Australian Journal of Science in 1957. It was here that Frank Macfarlane Burnet proposed his clonal selection theory (CST).9 CST appeared in the context of competing ideas of antibody formation, between those favoring instructionist and those favoring selectionist models for the origin of antibody specificities.¹⁰ Burnet's CST posited that individual cells bearing single receptor specificities were subsequently selected by antigen to divide and expand clonally-a revolutionary idea. This theory potentially resolved a number of questions, including immunological memory (a long-lived clone), tissue specific responses (clones residing in different tissues), autoimmunity (clone with a mutated antibody), and tolerance (self-reactive clones deleted early in development). As mentioned in a recent review celebrating CST's fiftieth anniversary, a corollary of CST is the requirement of a diversity of receptors present on the surface of B cells upon which selective forces may act.¹¹

In principle, there are two ways antibodies could end up detecting antigen and proliferating to quell an invasion. In an *instructionist* model, an antibody's shape is directly influenced by contact with antigen, whereas in a *selectionist* model, a pre-existing antigenic specificity is chosen (selected) by antigen from a presumably diverse pool. That is, either the antibody changes as it contacts antigen or else the body is making many types of antibodies even before it is exposed to antigens. The history of instructionist vs. selectionist models is rather convoluted, with individual researchers changing their views over time, as new experiments became known. One of the earliest instructionist models was Paul Ehrlich's "side-chain" theory.¹² The side-chain theory persisted through the 1960s and seemed to agree with Jacques Monod's findings in bacterial enzymology: just as bacterial enzymes seemed to adapt to alteration in their sugar fuel, as understood at the time, pathogens were thought to imprint their shapes onto the immune-globulin proteins, inducing them to change shape in response. The demise of instructionist models largely came about as the result of an increasing understanding of molecular genetics and molecular biology, which began in earnest following Watson and Crick's discovery of DNA's structure in 1953.

Ultimately, the solution to the diversity question, and the identity of immunology's G.O.D., provided some insights into the development of self-nonself identity within the immune system, and a convincing confirmation of the clonal selection theory. By the late 1970s and early 1980s, the realization that antibody-producing cells were clonally selected focused attention on what was happening at the genetic level. Was there something special about the antibody genes that allowed for production of such a large potential pool of different specificities to be manufactured? Indeed, there was, and sequencing the genes eventually told much of the story of what was going on.

Explaining Receptor Diversity

A number of ideas were put forth to explain the great diversity seen in the antibody proteins. The nature of the problem was extended when it was realized that antibodies could be generated against compounds not found in living cells or in the natural environment, such as 2,4-dinitrophenyl¹³ or 2-phenyl-oxazolone.¹⁴ One explanation for the great diversity is that our DNA, passed down through the generations, might encode many different antibodies, enough to bind every conceivable antigen, and the appropriate ones are selected when needed. But this proposal requires that a very significant proportion of the genome be devoted to antibodies.

Research over the past forty years has uncovered many details of the genetic mechanism that produces diversity in the receptors of B cells (antibody molecules). Indeed, it has proven true that much of the raw material for the antibody repertoire is encoded in the genome, and yet the antibody repertoire is also distinctly molded by the environment, but not in the way the instructionists had proposed. The G.O.D. mechanism began to be revealed when

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methods for determining the amino acid sequence of antibody proteins were developed, in concert with DNA sequencing technology. The key discovery – one totally unprecedented – was that *multiple combinations of gene segments are assembled to form the final antibody gene.* The precursors of antibodyproducing B cells are continually produced from the bone marrow, and in the process of B cell development, the antibody genes are rearranged to generate novel specificities. This is unlike most genes, in which the genetic code is read off as a blueprint for assembly of a single, defined amino acid sequence of the protein. These changes in the DNA, which are randomly generated as described below, produce the variability seen in the antibodies.

How Antibodies Are Formed

Antibodies are Y-shaped proteins made of a light chain and heavy chain paired as shown in Figure 1. The heavy and light chains fold together so that their amino terminal ends (NH_3^+) form the antigenbinding site.

As mentioned above, amino acid sequencing, and later DNA sequencing, revealed a high degree of



Figure 1. The basic structure of an IgG antibody protein.¹⁵ The structure is composed of two light chains and two heavy chains. The three constant domains of the heavy chain are denoted (CH₁, CH₂, CH₃). Disulfide bonds (S-S) hold the structure together in a H₂-L₂ stoichiometry. The variable domains of light and heavy chains (VL, VH) are the parts of the antibody that are encoded by gene segments which undergo the sorts of rearrangements described in the text, giving rise to tremendous diversity in the amino acid sequences and, therefore, antigenbinding specificity. The D and J segments are shown in their approximate positions along the variable domain. Less variable parts are known as framework regions (FR) and are involved in the protein's folded structure, rather than in antigen binding. CDRs are complementarity determining regions that loop out and contact antigen.

sequence diversity in the variable domains of both the heavy and light chains. The observation that there was a variable end and a more constant region led Dreyer and Bennett, in 1965, to propose the existence of a large number of variable "genes" which would rearrange and join with a fewer number of constant genes.¹⁶

In 1970, amino acid sequencing of the amino termini of 64 different antibody light chains revealed a significant degree of diversity, with a degree of similarity such that variable segments could be grouped into families. This prompted the authors, Hood and Talmage, to propose the possibility that 10,000 light chain genes, in combination with 10,000 heavy chain genes, could produce 100 million specificities.¹⁷ With some back-of-the-envelope calculations, they figured that this would only require 0.4 percent of the 3 billion basepairs of the human genome. Hood and his colleagues would have been surprised to learn that less than about 1.5% of the entire human genome actually encodes protein, as revealed by sequencing the entire genome,¹⁸ and that we actually have somewhere in the vicinity of 25,000 protein-encoding genes total.¹⁹

Once antibody genes began to be sequenced, it became apparent that large numbers of genes was not the answer. One clue to the source of diversity came with the findings of Susumu Tonegawa, that the DNA encoding the antibody genes found in antibody-secreting B cells was markedly different from the same region of DNA isolated from sperm cells or body cells of the same animal (the germline DNA). Something unprecedented had happened to the immunoglobulin genes during the process of B cell development-parts of the genes had rearranged, confirming the Dreyer-Bennett hypothesis.²⁰ This finding was significant enough to earn Tonegawa a Nobel Prize in 1987. By the early 1980s, DNA sequencing of numerous light and heavy chain genes from B cells, as well as the entire germline region, had revealed the presence of gene segments which were joined together (rearranged) to form the final productive antibody heavy and light chain genes.²¹

By comparing DNA sequences of germline, unrearranged DNA with the sequences of rearranged antibody genes, it became clear that there were three distinct types of gene segments that combined to encode the antigen-binding part of the antibody heavy and light chain genes. These are now known as V (variable), D (diversity), and J (joining) segments. Once the variable region had rearranged, a final step of recombination brought the rearranged variable segment in contact with the C (constant) gene region, and a complete antibody gene was then ready to be transcribed and translated into protein. A rearranged light chain gene is formed by a recombination event in which a single V gene segment combines with a J segment. Next, this V-J is joined with the remaining invariant portion of the gene, the constant region (C region). A rearranged heavy chain gene is similar but slightly more complicated, as it involves the additional diversity (D) segment, with $D \rightarrow J$ joining first, then $V \rightarrow DJ$ joining, followed by VDJ \rightarrow C joining. Immunologists have been known to say unusual-sounding things like "V to D-J" and "V-D-J to C," and they actually know what they are talking about. (You may need to read those last few sentences again, or just skip ahead.) The layout of gene segments for the heavy chain genes in mice is shown in Figure 2. Humans have a similar arrangement.

This process of gene rearrangement is known as V(D)J recombination, and is supported by a mountain of experimental evidence, including identification of the targeting sequences flanking each of the gene segments, and the rules which ensure that the segments assemble in the proper order (not V to V, for example), as well as the identification of the specific recombination genes (RAG1 and RAG2) that accomplish the rearrangement with help from several DNA housekeeping enzymes.²²

An important component of V(D)J recombination that injects a significant degree of additional

randomness (unpredictability) into the process is the *imprecision of the joining mechanism*. During the cutting-and-pasting process, each double-stranded DNA end is temporarily held in a closed hairpin configuration. This hairpin is then enzymatically cleaved, often off-center, which, upon extending outward, can add several additional nucleotides. (These are called palindromic "P" nucleotides, since they spell out a short DNA palindrome as a result of the hairpin mechanism.) In addition, several nontemplated nucleotides, known as "N" additions, may be added by the enzyme terminal deoxynucleotidyl transferase (TdT).23 These additional P and N nucleotides added at the junctions between V, D, and J segments add a significant amount of diversity to the repertoire, as the greatest amount of variation is seen precisely at this junction. (CDR3 in Figure 1.)

Tonegawa noted that the imprecision of DNA end joining produces diversity which comes at the expense of significant losses because of shifts in the reading frame, which result in a nonviable protein upon translation.²⁴ Since amino acids are encoded three at a time, if one or two nucleotides are inserted at a junction, the ribosome will be shifted to a new reading frame, and amino acid "nonsense" will be produced until a stop signal is reached, which usually prematurely truncates the amino acid chain. Since there are two copies of each genetic locus, the B cell has two opportunities to arrive at a productive rearrangement for each antibody chain.

At this point, it may be helpful to summarize some of the contributions to generating diversity in the antibody repertoire. Each of these steps involve a degree of unpredictability and chance:



Figure 2. The process of V-D-J joining in the heavy chain of antibody is illustrated. There are hundreds of V regions, dozens of D segments, and several J segments. The VDJ junction thus created will then join with one of the C region gene segments to form the complete antibody gene.²⁵

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- 1. Two Chains: The antigen binding site is a combination of one light chain with one heavy chain which are encoded separately in the genome;
- 2. Many V Regions: Each antibody gene is formed by selecting one from among many variable region-encoding genes (hundreds);
- 3. Additional Gene Segments: Each of the variable regions is actually a combination of multiple gene segments; for the light chain, V+J; for the heavy chain, V+D+J;
- 4. Junctional Diversity: The junctions between the gene segments are joined in an imprecise manner.

For completeness, I should mention one other mechanism that introduces diversification of antibodies through continued, targeted mutation within the rearranged antibody genes. This happens when clones of stimulated B cells are rapidly dividing in the immune organs such as the spleen and lymph nodes. Here, single base mutations are introduced within the antibody genes, which may or may not result in amino acid changes. There is apparently a competition within these immunological organs for B cells with increased antigen-binding affinity, and those cells with mutations resulting in higher affinity have a selective advantage over their nonmutated siblings. This final level of antibody diversification, known as somatic hypermutation, has been reviewed in detail recently, and the chief enzyme responsible, a cytidine deaminase, has been identified.²⁶ This mechanism helps explain so-called affinity maturation, in which antibodies appearing after multiple booster immunizations have greatly increased binding affinity compared to those arising after a single immunization. This is another example of randomness with a purpose; it is a microcosm of evolutionary competition and survival of the fittest on a cellular scale.

A mathematical formula expressing the contributors to this diversity was presented by Tauber and is as follows:

$s_m (f_1 V \times J \times f_2 V \times D \times J)$

with the factors V x J and V x D x J being the light and heavy chain combinatorial diversity, f_1 and f_2 representing the factor of light chain and heavy chain junctional diversity due to flexible joining mechanisms, and s_m being the factor due to somatic point mutations involved in affinity maturation.²⁷ This system is remarkably economical from a genetic standpoint, as it is theoretically capable of generating on the order of 1×10^{10} different antibodies from only approximately 500 gene segments.²⁸ No matter what the precise value is, clearly it is a very high number, and the mechanisms shown provide a satisfactory explanation for the ability of animals to make specific antibodies against practically any appropriately sized molecule.

In describing the above system, I have shown that random, or highly unpredictable events occur at a number of points in the process whereby mature antibody encoding genes are formed. This process involves the imprecise joining of gene segments chosen from a pool of possible choices. As a result of this mechanism, the way the final light and heavy chain polypeptides will come together as a folded protein is absolutely not specified in advance, and seems left to chance. Superimposed on this system is the requirement that the antibody produced not be self-reactive. Self-reactive B cells self-destruct early in development before they escape into the peripheral tissues, which solves the problem of autoimmunity. Also, many antibodies that could potentially be useful are produced and then die naturally without ever being stimulated or "called to action" by disease. Our bodies continually manufacture novel specificities to fight off new invaders, and also rely on the memory of past battles to fight the same disease more quickly when it is again encountered, by setting aside a cadre of long-lived memory cells.

Without the chancy and random nature of the recombination process, it would not be possible to generate the diversity required to protect from disease with the amount of DNA allocated to this function. Of course, we should not think of this randomness as complete chaos, since the joining process is tightly controlled and mutations are targeted to the appropriate parts of the genome. Yet it would be hard to argue that randomness plays no role in the system. Not only is there a clear role for randomness, but randomness is also the key secret to the success of the recombination process in generating extremely high levels of diversity with a modicum of DNA raw material. Since only the useful and non-self-reactive specificities are selected for clonal expansion, the system, in the end, seems more intelligent that it actually is. At this point, let us consider the role that God may be playing in the immune system, and by extension, in the natural world more generally.

Philosophical and Theological Implications

A considerable amount of literature addresses God's role in creation, and most traditional Christians (such as those attending and teaching at my college) would agree with the basic statement that God, indeed, did create the cosmos, which is the sum total of all we observe (and even that which we do not observe) in our universe. On the subject of God's role in creation, the Westminster Larger Catechism (1647) states: "God executes his decrees in the works of creation and providence, according to his infallible foreknowledge, and the free and immutable counsel of his own will." I have found much agreement among believers that God is the Creator of all things, including the very large, such as the distant galaxies and the solar system, and the very small, including atoms and macromolecules like DNA or antibody proteins.

Christians can also agree in the biblical concept that God is not only the Creator but also the Sustainer of all things. God "upholds the universe by his word of power" and "in Christ all things hold together" (Heb. 1:3; Col. 1:17). Yet, it is important for us to examine these terms more carefully. What do we precisely mean when we say that God sustains and creates? How does he sustain, and through what means or mechanisms is creating accomplished? For example, a plain reading of Scripture gives the impression that God's creative acts occurred in the blink of an eye:

And God said, "Let the waters teem with living creatures, and let birds fly above the earth across the expanse of the sky." So God created the great creatures of the sea and every living thing with which the water teems ... (Gen. 1: 20–21).

This description of God's activity in creation is quite different from the accepted scientific explanation. Any discussion of how God acts in the world must consider the fact that science has made great progress in understanding a great many details about the inner workings of not only the stars and planets, but also of living systems – something that would have been utterly unimaginable in biblical times.

Science has been so successful that, for a number of increasingly outspoken atheist scientists, this scientific level of understanding is, for them, sufficient in and of itself. A small but vocal number of these scientists have forcefully argued that a scientific understanding should be sufficient for Christians as well. One does not need to search very hard to find a quote from a prominent scientist deifying random processes, or at least suggesting that randomness plus time is a complete explanation. One well-known and possibly apocryphal example is from biologist Richard Dawkins: "Life results from the nonrandom survival of randomly varying replicators."29 At this point, I would like to keep in mind the title of a popular book on the controversial subject of origins: God Did It, but How?³⁰ Fischer's book, which I first read as an undergraduate, underscores the essential and important point on which all Christians can agree: God is ultimately responsible for the existence of the universe and all that it contains. God did it.

Now we come to the more interesting discussion of God's role in the kind of chance processes such as those I have described for antibody gene rearrangement, but which are also found in many other biological processes. Again, I am defining random in the sense of highly unpredictable, highly contingent processes. One of my goals here is to raise awareness of work in philosophy addressing the issue of randomness in nature. My opinion is that this issue of randomness, chance, and seeming unpredictability found in nature lies near the heart of the struggle that many believers have with evolutionary science. It is particularly problematic if any kind of chance-based mechanism is dismissed out of hand as simply incompatible with a biblical worldview. I hope that I have clearly painted a picture of how chance and stochastic processes are important to the normal functioning of the immune system. However, this still leaves open the question of God's role in the process, and whether or not he is limited in his future knowledge.

The late theologian and biochemist Arthur Peacocke directly addressed philosophical and theological questions of how God acts in the world. Peacocke was critical of his fellow biologist Jacques Monod's view that "only" chance was responsible for the world, stating that he saw no reason to elevate the observations of chance events to a metaphysical principle.³¹ In his monograph, Peacocke provided a helpful explication of two meanings of chance. There is, on the one hand, the kind of chance seen in flipping a coin. In this instance, if one knew all the variables of force,

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friction, and so forth, one could predict the landing as heads or tails. This really is not chance at all, but simply lack of precise knowledge. The second kind of chance he discusses is, I think, more applicable to antibody rearrangement. This is the kind of "accidental" intersection of two (or more) unrelated causal chains. The example he uses is one of a hammer falling from a building and hitting an unfortunate passerby on the head. One event is unrelated to the other, and it is a pure accident that they occurred together. As Peacocke states,

There is no connection between these two causal chains except their point of intersection, and when the hammer hits you on the head could not have been predicted from within the terms of reference of either chain taken by itself.³²

I think it is this second type of randomness that occurs in V(D)J recombination in antibody genes. For example, first one particular V region joins to a particular J region, and in the process, the hairpin loop of DNA then happens to be opened at one particular position, followed by the insertion of, say, six nucleotides, each of which could be A, C, G, or T. This is indeed a collection of independent events that together may (or may not) eventually produce a single product, a functional antibody gene. Despite Peacocke's acceptance of accidental events in biology and in the world of falling hammers, he viewed all events, including the random ones, as God's hand at work. His view "posits that God exists and interpenetrates every part of nature, and timelessly extends beyond as well."33 In this scheme, if God were not to exist, so also all matter and energy of the universe would cease to exist; however, God is also transcendent over the universe.

In David Bartholomew's recent book, *God, Chance and Purpose: Can God Have It Both Ways?* he argues that chance events, rather than running counter to the idea of a sovereign God, are actually an essential component of the world. Chance events should be seen as *within* the providence of God. As he writes, "chance is a necessary and desirable aspect of natural and social processes which greatly enriches the potentialities of the creation."³⁴ In the example of antibody diversity, it should be apparent that without the random nature of its mechanism, the cell would require a much more bulky system, involving dramatically more actual nucleic acid content (numbers of genes). Not all Christians agree with Bartholomew's view. In a review of Bartholomew's book, intelligent design theorist William Dembski outright rejects the possibility that uncertainty (randomness) exists in the universe, at least from the point of view of God, the idea being that we only *think* certain things are random, but they really are not.³⁵ Dembski further criticizes Bartholomew for a "surprisingly shallow" view of chance, saying that he does not tell his readers what chance is. I hope that my example of antibody rearrangement has clearly indicated, at the very least, what I mean by the terms randomness and chance.

Dembski argues that if God were to allow randomness, then he is no longer able to know all things, and could not know the future because it would be a random outcome. I prefer to leave open the possibility that what we perceive as chance or random events really are God's doing. This is consistent with Remmel's view, mentioned earlier, wherein God chooses the random numbers that drive natural events. He is "doing" it, and it is random (to us). I am comfortable accepting the seemingly contradictory ideas that God can both allow randomness and also know the future. Since God operates and exists in a dimension where time has no limitation for him, he is in the past, present, and future all of the "time." He knows the future, because he has been there (and is there). We, who cannot know the future because we are "stuck" in the present, are only projecting our limitations on God when we say he is limited by present randomness and uncertainty. If the randomness that we see is merely an illusion, as Dembski seems to suggest, I suppose that is one way to resolve the paradox. For all practical purposes, however, and from our human perspective, we may as well consider randomness to be 100% real. We should work diligently to understand how randomness may be involved in natural processes, and, at the same time, understand that God is carrying out his ultimate ends as revealed by Scripture.

God is answering prayer, creating divine appointments and coincidences for those who are under his mantle of care and who call on his name. Critics of evolutionary science such as Phillip Johnson have argued that "methodological naturalism" is an allencompassing worldview which is contrary to biblical Christianity. He sparked the intelligent design movement as a way to detect the supernatural or to inject the designer into the daily bench work done by working scientists, an effort which will be doomed to failure if random processes are, in fact, a major part of God's way of working in the world. The challenge therefore remains, to explain the randomness theologically. We must not stick our heads in the sand and pretend that randomness does not exist, or try to define it away. In a pre-Darwinian world, the knowledge of randomness in nature was greatly diminished. In the twenty-first century, theologians may be playing a catch-up game with science. And despite the good work that has already been done, many lay people remain unaware, and often see science and faith at odds with each other.

This discussion has done little to resolve how we are to understand God's precise role if randomness is the normal way nature works. It may be as John Polkinghorne has suggested, that the existence of quantum uncertainty is what allows God room to work.³⁶ There are two extreme viewpoints. In one, God is continually moving every individual atom, every raindrop. As John Calvin wrote, "it is certain that not a drop of rain falls without the express command of God."³⁷ This view is seen even today in the lyrics of popular worship songs such as "Indescribable," by Chris Tomlin, in which God is described as playing a very active role in natural events:

> Who has told every lightning bolt where it should go Or seen heavenly storehouses laden with snow Who imagined the sun and gives source to its light Yet conceals it to bring us the coolness of night?³⁸

The opposite extreme is that of a strictly material world in which each atom goes about its business with no room whatsoever for God's action. Peacocke's view has the atoms going about their business, but God being intimately involved in the process. In Finlay's article on random process and divine purpose, he points to a third option, that nature has *relative autonomy*. This means that God allows nature to have a self-sufficient mode of operation, but that this autonomy is completely dependent on God conferring it on the natural realm.³⁹ I should mention that this autonomy can be seen as parallel with free will of humankind. If God is able to be

sovereign in the face of humans' free will, it seems to me that he is also able to be sovereign in the face of molecules' random behavior. I realize that the topic of free will is a deep one, itself open to debate among various branches of Christendom, and we should not be sidetracked by this fascinating and potentially irresolvable topic. I would note that the topic of free will in nature has been explored by Polkinghorne and others.⁴⁰

The inside front page of Arthur Peacocke's 2004 edited volume entitled "*Evolution: The Disguised Friend of Faith?*" contains a fascinating quote from Aubrey Moore, one of the first clergymen to openly accept Darwinian evolution by natural selection and incorporate it into his theology. These words were published about thirty years after publication of Darwin's *On the Origin of Species*.

The one absolutely impossible conception of God, in the present day, is that which represents him as an occasional visitor. Science has pushed the deist's God further and further away, and at the moment when it seemed as if He would be thrust out all together, Darwinism appeared, and, under the disguise of a foe, did the work of a friend ... Either God is everywhere present in nature, or he is nowhere.

A. L. Moore (1848-1890)⁴¹

Given these options, I would emphatically agree that God is everywhere present in nature, even though he may seem disguised behind events that to us seem very random, chancy, and uncertain. To me, it is glorious, indeed, to consider that from the randomness in the world of biology arise the many good things we enjoy, and for which we give God thanks. The combination of chromosomes in sexual reproduction gives rise to the variation we see among living organisms; random combinations of gene segments allow us to defend against every bacterium and virus that comes our way. There probably is no way, humanly possible, that we will ever fully grasp how God is able to know the future, yet still allow nature to have autonomy; yet I am personally comfortable with that paradox. I believe and trust that God is at work in the world, and not distant, faithfully bringing about his ultimate aims, while, at the same time, allowing raindrops, lightning bolts, and antibody genes to operate with their own economy, under his all-knowing care and ultimate authority.

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Notes

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Interview

Chemist as Complementarian

An Interview with Robert C. Fay

Karl E. Johnson and Keith Yoder

ollowing the Morrill Act of 1862, Cornell University was founded in 1865 as New York State's landgrant institution. Four of Cornell's seven undergraduate colleges are public institutions, and the university is committed to extension work throughout the state.

Cornell continues to be informed by its founding vision not just organizationally but also philosophically. Andrew Dickson White, who once called the University of Berlin "my ideal of a university not only realized – but extended and glorified," founded Cornell as a "non-sectarian" institution and "an asylum for Science." The epistemological assumptions that informed *the founding of Cornell – that autonomous* human reason is inconsistent with and to be privileged over revealed religion – were made more explicit in White's two-volume History of the Warfare of Science with Theology in Christendom (1896). In part for these innovations, educational historian Frederick Rudolph once called Cornell the "first American university."

Cornell continues to be entrenched in debates about how faith and science ought to interact, if at all. Will Provine and the late Carl Sagan have been outspoken advocates for a naturalistic view of the world. As recently as 2005, President Hunter Rawlings III devoted his State of the University Address to decrying "religiousbased opposition to evolution," specifically intelligent design.

Nevertheless, the Cornell faculty is diverse, and includes a number of "complementarians" – those who see science and religion as two different ways of knowing that may inform each other, but which need not be in conflict. One such individual is Robert Fay, professor emeritus of chemistry and chemical biology at Cornell University. In addition to his professional work as a chemist, Bob is an active member of Bethel Grove Bible Church, an advisor for the Cornell chapter of InterVarsity Christian Fellowship, and a founding board member of Chesterton House, a Center for Christian Studies at Cornell. He graciously agreed to sit down and discuss how his faith informs his science, and how his work as a scientist informs his faith.

We understand you went to Oberlin College. What was your undergraduate experience like? What influenced you to be a chemist? What experiences in college influenced you to continue in the Christian faith?

A In the mid 1950s, when I was an undergraduate, Oberlin was a



Keith Yoder



Karl E. Johnson is the founding director of Chesterton House, a Center for Christian Studies at Cornell University. He received his bachelor's, master's, and doctoral degrees from Cornell University, after previously serving for ten years as program director for Cornell Outdoor Education. Johnson's article "The Curious Case of Galileo Galilei (in which he does not go to jail)" appeared in a recent issue of Sightings, a publication of the Martin Marty Center for the Advanced Study of Religion.

Keith Yoder graduated from Cornell University with a degree in human development; he is currently working at Cornell as a research assistant in a neuroscience laboratory. His recent work has focused on understanding the etiology of autism and evaluating therapies targeted at children with autism spectrum conditions. He plans to continue his education in a doctoral program relating to affective neuroscience. When not analyzing electroencephalograms, Keith builds websites for a technical consulting business he started and, along with the help of his wife, coordinates the youth program at his church.

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wonderful place – academically rigorous, racially and culturally diverse, with a rich legacy of social justice concerns. Oberlin was the first co- educational college in the U.S. and the first college to admit African-Americans (in 1834). Prior to the Civil War, it was a hotbed of the abolitionist movement and was a key stop along the underground railroad.

In addition, because of its outstanding conservatory of music, Oberlin was a place where one could go to a concert or a faculty or student recital four or five nights a week. It was a great place for people like me who enjoyed classical music.

My interest in chemistry was sparked by a very good high school chemistry teacher. My tentative plan was to become a liberally educated chemical engineer by pursuing a five-year joint Oberlin-MIT program that would result in an AB degree from Oberlin and an engineering degree from MIT. In my first two years at Oberlin, however, I became so interested in chemistry that I decided to bag the MIT part and do a standard chemistry major at Oberlin.

In my senior year, as a result of considerable growth in my Christian faith, I began to wonder if I should go into some form of Christian ministry, perhaps pastoral ministry. A wonderful opportunity opened up for me to spend a year pursuing biblical studies in Wheaton Graduate School and at the same time serve as a teaching fellow in the Wheaton Department of Chemistry. This allowed me to keep one foot on each side of the fence while seeking God's direction for the future. As a result of my experiences at Wheaton and in a summer chemistry research job at the National Bureau of Standards in Washington, I became convinced that my calling was in college or university teaching, rather than in pastoral ministry.

You asked about college experiences that influenced me to continue in Christian faith. I had grown up in a Christian home and in a small church, but like so many other Christian students, it was in college that I reexamined the foundations of the faith I had accepted as a child.

In my high school, Christians were known as people who didn't participate in certain social behavior and as a result were somewhat socially isolated. At Oberlin, Christians were known as people who believed that Jesus Christ was Lord and Godand there weren't very many of us, only a half dozen or so in the Inter-Varsity group, the evangelical only Christian group on campus. So, the



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issues were clearly theological; I had to find out what I thought of Jesus Christ. Through serious study of the gospels, discussions with others, and regular participation in the InterVarsity group, I became convinced that the claims of Christ were credible. Though not all of my questions were answered, I was satisfied that my faith was based on a firm foundation.

Whether out of necessity or a voluntary narrowing of interest, many academics invest their time and energy almost exclusively in their area of academic specialization. But you have devoted a lot of time not only to the study of chemistry, but also to the history of science in general. What motivated you to set such a high priority on studying the history of science?

A I suppose my interest in history goes back to my years in Oberlin. I took five history courses, including a superb two-semester course in the intellectual history of Europe. Although this course focused primarily on the history of philosophy, religion, literature, art, and music, it touched on science as well. During graduate school years and the first twenty-five years or so of my time at Cornell, my academic interests were pretty specialized, like those of most of my colleagues. When I became the coauthor of a general chemistry textbook in the late 1980s, I began to learn more about the history of chemistry.

Travel also played an important role. I spent a year on sabbatical leave in Oxford, where Robert Boyle, the father of modern chemistry, carried out his experiments on gases and formulated the law that bears his name. While a visiting professor at the University of Bologna in Italy, I visited the astronomical laboratory where Copernicus had been a student. About ten years ago, I went on a history tour of Britain and Ireland that was organized by the American Scientific Affiliation; this included a visit to the home of Sir Isaac Newton in Woolsthorpe, where he developed his theories of gravitation and optics, and where he developed the calculus during the two years that Cambridge University was closed as a precaution because of the plague.

Perhaps the most helpful influence on my interests was a summer course at Regent College, Vancouver, BC, taught by Mark Noll and David Livingstone, that focused on the historical interactions between science and Christianity. This course exposed me to the literature of this field and has kept me reading in subsequent years.

Q Here at Cornell, you're an advisor for Cornell Christian Fellowship (an undergraduate InterVarsity fellowship). Undergraduates often experience a "compartmentalization" between their academic and religious experiences. How important is it for undergrads to relate or "integrate" their faith and their studies? Why?

A I think it is important for students (and faculty) to relate their faith and their academic work because we are whole persons and the whole of reality is dependent on the Creator. In the study of science, we investigate God's handiwork in the natural creation, and in the study of the arts, we explore God's handiwork in the human creation. Of course, the ease of making connections between our faith and our studies depends on the subject. The connection to theorems in mathematics may appear remote whereas the connection to the paintings of Michelangelo, for example, is quite obvious.

Even in the case of mathematics, however, there may be a connection. It's interesting to ask why mathematics, an abstract activity of the human mind, should be related to the physical structure of the universe. The physics Nobel laureate Eugene Wigner has described this connection as "the unreasonable effectiveness of mathematics," and has said that it was a gift we neither deserved nor understood. John Polkinghorne has suggested that Christian belief provides a satisfying explanation: "The reason of our minds and the rational order of the universe are integrated because both have a common origin in the Creator, whose mind and will is the ground of all that is."

So because God is Creator of all things and Christ is Lord of all, studying the things he has made is a part of what it means to love God with our mind, as well as with our heart, our soul, and all our strength. The more we learn about this wonderful world, the more fully and intelligently we will be able to glorify its maker.

Q In your article "Science and Christian Faith: Conflict or Cooperation?" in *In Pursuit of Truth: A Journal of Christian Scholarship* (August 2007) you quote Galileo as saying that "Both the Holy Scriptures and Nature proceed from the divine Word" and you give his warning against "the carrying of Holy Scripture into dispute about scientific conclusions." Why should Christians be wary of bringing the Bible to "scientific" debates? Is the point that the Bible should not be regarded as a scientific text, or that religion and science deal with qualitatively different subject matter (or something else entirely)?

A Both of these points are important. At the time of Galileo, the dispute was whether the sun revolves around the earth, as believed by Aristotle and Ptolemy, or whether the earth and the other planets revolve around the sun, as believed by Copernicus and Galileo. In support of Aristotle, the Catholic Church cited Scriptures, such as Ps. 93:1: "The world is firmly established; it cannot be moved." Galileo famously countered: In the Bible,

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the Holy Spirit intends to teach "how one goes to heaven, not how the heavens go," i.e., the Bible is not a scientific textbook. Basically, I think that's right.

Scripture's claim for itself is that it is intended "to make us wise for salvation through faith" and that "it is useful for teaching, rebuking, correcting and training in righteousness" (2 Tim. 3:15–17).

I agree with Galileo's conviction that God has revealed himself in two books, the Book of Nature and the Book of Scripture, and that these two books cannot contradict one another. Our problem is that we tend to read Scripture through the lens of twenty-first century mechanistic science and forget that much of the Bible was written in highly figurative, anthropomorphic, and phenomenological language, and was addressed initially to people who lived thousands of years ago. To interpret it properly, we need to understand ancient cultures and the literary genres in which Scripture is expressed.

On the second point, I do believe that science and Christian faith answer largely different kinds of questions. Science is concerned with the properties and patterned behavior of material systems and with cosmic history. Science traces the history of the cosmos from the big bang to the condensation of galaxies, from the evolution of the chemical elements in the interior of stars to the evolution of carbon-based life.

Science answers mechanistic questions. It seeks to understand how the natural world works and explains its working in terms of natural causes. Its method is methodological naturalism. Science has nothing to say about the spiritual world. It neither affirms nor denies, at least when it's speaking as science, the existence of a spiritual world. John Polkinghorne has said that the great success of science has been purchased at the cost of the modesty of its ambitions.

So the scope of science is clearly limited to the material world. Christian faith does not offer a mechanistic description of material behavior. It is concerned with a different set of questions – questions such as the following: What is the ultimate cause of the existence of the universe? Who governs

the material world, or is it self governing? What is the meaning and purpose of human life? These are metaphysical questions – questions that are not answered by science. For answers to these questions, Christians turn to God's revelation in Scripture.

Are there areas where science and Scripture intersect? I think Stephen Jay Gould's idea of nonoverlapping *magesteria* goes too far. Surely, it is significant that most of the leaders of the scientific revolution of the sixteenth and seventeenth centuries were Christians and that their Christian worldview presuppositions about the orderliness, uniformity, contingency, and intelligibility of nature were influential in the development of modern science.

I suppose there are a few questions in which the subject matter of science and religion overlap, e.g., Did the universe have a beginning or is it eternal? The Bible teaches that only God is eternal and that everything else is created, and thus the universe did have a beginning. Modern cosmologists also believe that the universe had a beginning, the big bang, and date it 13.7 billion years ago.

Another area of overlap might be biblical archeology. Archeologists use scientific methods in investigating historical matters reported in the Bible.

You conclude your article with a quote from Francis Bacon:

Let no man ... think or maintain that a man can search too far or be too well studied in the book of God's word or the book of God's works, divinity or philosophy (i.e., science) ... Only let men beware ... that they do not unwisely mingle or confound these learnings together.

How do your science and faith influence each other without "unwisely mingling or confusing these learnings together?"

A I suppose the most common example of unwise mingling is the use of Scripture, or more accurately a particular interpretation of Scripture, to answer scientific questions. This was the mistake the Catholic Church made in the Galileo affair. Incidentally, that conflict was not a clash between science and religion, as so often believed, but rather an intramural dispute about scriptural interpretation among people all of whom claimed to be Christians.

A contemporary example of unwise mingling would be attempts to use the biblical genealogies to determine the age of the earth. A large body of scientific evidence has established that the earth is ~4.5 billion years old. This is so well established that it should not be controversial. Yet a large number of Christians think that Scripture requires them to believe that the earth is no more than ~10,000 years old. This view is an impediment to the advance of the gospel and is damaging to the faith of Christian students.

More than 1,500 years ago, St. Augustine warned against interpreting Scripture in a manner that contradicts well-established facts known about the natural world. He wrote:

Usually, even a non-Christian knows something about the earth, the heavens, and other elements of this world, about the motion and orbit of the stars and even their size ..., and this knowledge he holds to as being certain from reason and experience. Now, it is a disgraceful and dangerous thing for an infidel to hear a Christian, presumably giving the meaning of Holy Scripture, talking nonsense on these topics; and we should take all means to prevent such an embarrassing situation, in which people show up vast ignorance in a Christian and laugh it to scorn ... If they find a Christian mistaken in a field which they themselves know well and hear him maintaining his foolish opinions about our books, how are they going to believe those books in matters concerning the resurrection of the dead, the hope of eternal life, and the kingdom of heaven ...?

How do science and faith influence each other without "unwisely mingling these learnings together"? Among the gifts of Christianity to science are moral values, values of honesty, integrity, generosity, and collegiality—honesty in the recording and interpreting of data, generosity in acknowledging the contributions of others, and kindness in the way we treat our students and colleagues. Modern science was nurtured in the Christian civilization of Western Europe, and the legacy of Christian values continues to influence the way we do science.

One of the gifts of science to Christianity is that it assists us in interpreting Scripture, perhaps more so in avoiding misinterpretations of Scripture.

Changing subjects, you have spoken in the past about the distinction between "natural" and "supernatural" being foreign to Scripture. What do you mean by that, and why does it matter?

A The word "supernatural" does not occur in Scripture. The notion that God is responsible for supernatural events (i.e., miracles), whereas

natural events occur on their own, is foreign Scripture. to According to the letter to the Hebrews, the entire creation is sustained by the powerful word of Christ through whom God made the universe. And Paul's letter to the Colossians



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tells us that in Christ all things hold together – everything coheres in Him. So God holds the universe in being moment by moment, and if he ever stopped doing so, it wouldn't run down gradually, as though it ran on its own. Instead, it would simply vanish.

Jesus spoke often of God's actions in the natural world. God feeds the birds of the air and clothes the lilies of the field. He acts in the events we describe as natural, as well as in those rare and unusual events we describe as supernatural or miraculous. The fact that God has delegated most

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of his activity to secondary causes allows us to understand the physical and biological mechanisms of natural processes but in no way precludes God's providential activity in the world.

Why does this matter? If we see God's activity in the natural as well as in the supernatural, we will have a bigger view of who God is, and that will lead us to worship.

A century after Cornell Co-founder and President Andrew Dickson White wrote *A History of the Warfare Between Science and Religion,* the "war" seems to be as strong as ever. What should the church be doing to seek a constructive way forward in this matter?

Actually, the second combatant in White's title was "Theology in Christendom," not religion in general. Sadly, the warfare between science and Christianity is waged by both militant atheists and fundamentalist Christians. Both believe that science, especially evolutionary biology, and Christian faith are incompatible.

What can the church do about this? First, let me say I'm deeply concerned about the large number of Christian students who lose their faith when they get to college or university. No doubt there are many reasons for this, but I suspect that one of them is that they have been taught that science and the Bible are in conflict and that evolution is some kind of a conspiracy designed to destroy their faith.

I think that churches—in our Sunday schools, youth groups, and from the pulpit—need to teach that science and Christianity are not in conflict. Pastors and other church teachers need to learn more science and, following Augustine and Galileo, should not interpret Scripture in a way that conflicts with well-established scientific facts. God has given us two books, and those two books cannot contradict each other. This truth should also be taught in the seminaries, where pastors are trained. I think that's where some of the difficulties begin. We also need to encourage more Christian young people to go into careers in science, especially academic careers. We need more Christian faculty in our colleges and universities who can help students recognize that the oft-cited conflict between religion and science is really a conflict between religion and materialism, i.e., philosophical naturalism, not a conflict between Christianity and science.

For young academics, who are starting their careers, they're looking at the prospect of being very busy, just to keep up with their obligations. I'm just curious what, if any, advice or suggestions you might have to maintain a priority on doing their work, while also maintaining and sustaining broader academic interests, that connect their academic specialty to Christian faith.

That's a tough question, and I'm not sure that ${f A}$ I was very good at this myself. I got involved in a number of things other than doing chemistry when I was a young assistant professor. I was a Sunday School teacher, I played the piano in my church, I was an advisor to the Cornell InterVarsity fellowship, and, at the same time, I worked very hard at chemistry. I worked very long hours and I think that I didn't always allocate my time with a great deal of thought and analysis. I did the things that came along that needed to be done, rather than setting out carefully designed priorities, so I don't feel like I'm an expert on this. I think that the tension between the busyness of academic work and our wanting to grow in our faith-not only in terms of worship and fellowship with other Christians, but also in having some time to keep reading and studying and growing intellectually and spiritually in areas that relate Christianity to broader issuesthat's an ongoing tension. For me, a lot of growth in that area has resulted from things I've been asked to do-give a talk to this group or do this or that other thing. And that gets you working and gets you studying, rather than laying out a plan for the next five years as to how one is going to grow in these areas. I think ideally long-range planning is what one ought to be doing, but I'm afraid I haven't been very good at it.

I'm curious if you have favorite authors or perhaps favorite titles of books or periodicals that you have found to be especially helpful.

A One of the first books I read in the "Christianity and Science" area, in part as a result of Charlie Hummel's visit to campus years ago to give a talk to the Cornell Graduate Christian Forum, was his book called *The Galileo Connection*. It's a nice review of the contributions of various Christians to science and then a broader discussion of how science and Christianity relate.

Other books that have been very helpful are the books of John Polkinghorne. Also, books by historians of science, people like David Lindberg and Ronald Numbers, have been very helpful. There's a lovely book by Lindberg called *The Beginnings of the History of Western Science* which discusses the period prior to Copernicus. C. S. Lewis's books have been very helpful. One that I particularly like is *God in the Dock,* which is a series of essays that Lewis wrote on a variety of topics.

Well, thank you very much. We appreciate your time and all your hard-won wisdom of all your years of study.

A You're very welcome. It has been a pleasure to talk with both of you. $\qquad \ast$





Edward B. Davis

Prophet of Science—Part Three: Arthur Holly Compton on Science, Freedom, Religion, and Morality

Edward B. Davis

The final part of this article examines Compton's views on immortality and the morality of atomic warfare. He affirmed life after death, basing this on his faith in the value that God places on the conscious persons produced by the divinely guided process of evolution; however, he did not accept the bodily resurrection of Jesus. He also used a type of "just war" theory to defend the decision of the American government to use weapons of mass destruction against Japan – a decision in which he himself had a prominent voice. Related to this, Compton suggested that divine providence had enabled a free nation to win the race to develop nuclear weapons. Anti-Semitism drew his opposition before, during, and after the war, as he served as Protestant Co-Chairman of the National Conference of Christians and Jews.

We could, in fact, see the whole great drama of evolution moving toward the making of persons with free intelligence capable of glimpsing God's purpose in nature and of sharing that purpose. In such a case we should not look upon consciousness as the mere servant of the biological organism, but as an end in itself. An intelligent mind would be its own reason for existence.

-A. H. Compton, 19351

Prophet of Science: Immortality and the "Supernatural"

Simultaneously with his new thoughts on freedom, Arthur Compton was also revisiting his belief in immortality, the subject of his second Terry Lecture at Yale and the final chapter in *The Freedom* of *Man* (1935). The two topics were very

Ted Davis, professor of the history of science at Messiah College, was a student of the late Richard S. Westfall, the principal biographer of Isaac Newton and a leading authority on the Scientific Revolution. Ted edited (with Michael Hunter) The Works of Robert Boyle, 14 vols. (Pickering & Chatto, 1999–2000), and a separate edition of Boyle's subtle treatise on the doctrine of creation, A Free Enquiry into the Vulgarly Received Notion of Nature (Cambridge University Press, 1996). He has also written numerous articles on aspects of the history of science and Christianity since 1650, including an article on modern Jonah stories in PSCF (December 1991) that has been featured on two BBC radio programs. He lives with his wife, Kathryn, in a semi-rural part of central Pennsylvania; they have two adult children.

closely related in his mind. Indeed, the Terry Lectures themselves grew out of a chapel talk that he presented to students and faculty at the University of Chicago, as part of an Easter 1930 symposium on "Immortality."

Four faculty members spoke at this seminal event. Compton and theologian Shailer Mathews favored immortality, while the opposite side was advanced by ethicist Thomas Vernor Smith and the great physiologist Anton Julius Carlson. Smith, who later served in the Illinois Senate and the United States Congress as a New Deal Democrat, was a member of the University Church of Disciples despite his skepticism about eternal life. In constant demand as a lecturer all over the nation, he was also a regular on radio forums, including the University of Chicago Round Table, a half-hour Sunday afternoon program on the NBC-Red Network. Compton, Smith, and Carlson did a Round Table together at least once, in November 1936, although I do not know the topic they discussed.²

An immigrant from Sweden, Carlson had served as a Swedish Lutheran minister in Montana for just one year before religious skepticism and a growing interest in nature took him to Stanford University for his doctorate. He began teaching at the University of Chicago in 1904, two years after Jacques Loeb moved to California, but his intellectual outlook was nevertheless shaped substantially by Loeb's reductionist writings. A few years before the symposium, Carlson had been president of the American Physiological Society. In 1941 he appeared on the cover of *Time* magazine, and three years later he was elected president of the American Association for the Advancement of Science. The American Humanist Association made him the first recipient of their Humanist of the Year award in 1953.³

Compton talked about this 1930 symposium on immortality many years later, at a week-long Institute on Religion and Contemporary Civilization,



NBC radio program, "The University of Chicago Round Table," November 5, 1936.

Left to right: T. V. Smith, A. H. Compton, and A. J. Carlson. Photo by NBC Universal Photo Bank, used with permission. Courtesy of Arthur Holly Compton Personal Papers, University Archives, Department of Special Collections, Washington University Libraries. held on the campus of UCLA in November 1944. It was arranged "at the request of a group of students," he recalled, and "the results of this symposium have continued far beyond events of the evening." Mathews "elaborated his thoughts in a little book," Immortality and the Cosmic Process (1933). Smith "became so convinced that the ultimate values are those that can be expressed only in working with people that he left the University halls for politics." And Carlson "was invited to elaborate his thoughts at a public lecture in the University auditorium," probably early in 1931; this longer address, which was printed twice, induced Compton to reply formally in The Scientific Monthly at the end of 1946 (see below). Rounding out the story, Compton said that his own lecture "became the starting point" of the Terry Lectures.⁴

If students had asked for the symposium, others in Chicago also wanted it—especially Shailer Mathews and his associates at the American Institute of Sacred Literature (AISL), a correspondence school for Protestant ministers based at the University of Chicago Divinity School. Founded in 1880 at the old Morgan Park Theological Seminary in Chicago to provide instruction in Hebrew, it had become, by the late 1920s, a very important part of the University of Chicago. Thousands of Protestant clergy and lay people enrolled in correspondence courses written by Divinity School faculty, and many more received some of the dozens of pamphlets on various topics printed by the Institute.⁵

In 1922, responding to the growing influence of William Jennings Bryan's crusade against the teaching of evolution, the AISL initiated a series of pamphlets on "Science and Religion" by distinguished scientists and clergy, which were distributed much more broadly than their other publications. With financial support from the Rockefeller Foundation and more than one hundred individual scientists, pamphlets were sent unsolicited to tens of thousands of high school principals, legislators, scientists, and clergy across the nation, spreading liberal religious opinions about science at a time when many conservative Christians saw science as inherently anti-religious.⁶ Pamphlet authors included Mathews, Caltech physicist Robert Millikan, Princeton biologist Edwin Grant Conklin, Columbia physicist Michael Pupin, and the famous Manhattan pastor Harry Emerson Fosdick (among others), all

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of them among the leading public intellectuals of the day.

Each of those men had already written for the series by the fall of 1928, when the AISL told the Rockefeller Foundation of their plans to add a pamphlet based on "A Symposium of Several Scientists-My Feeling about Immortality."7 Plans for this did not materialize until the spring of 1930, but Compton was ready to go several months earlier. A carbon copy of his chapel talk, missing the first page, is dated October 28, 1929 – an ironic fact, that his confession of faith in immortality was written simultaneously with the collapse of the stock market and the mortality of several of its desperate, overextended investors.8 The Presbyterian Banner published it two weeks after Christmas, in advance of the symposium, and reprinted it at Easter the following year, accompanied by the sermon that Charles Gilkey had preached on Easter Sunday 1930, outside of but in conjunction with the symposium. The Christian printed an abridged version of Compton's talk at the same time. Compton gave a similar address to the annual convocation of Presbyterian leaders at Wooster in June 1931.9 All four chapel talks were published by the University of Chicago Magazine in November 1930.¹⁰

Then, in September 1930, the AISL published 25,000 copies of a shirt-pocket-sized, 45-page pamphlet, Life After Death, containing the talks by Compton, Mathews, and Gilkey.¹¹ Compton no doubt helped to distribute this on campus, just as he must have distributed other AISL pamphlets on science and religion. Mathews and Gilkey were his friends, he had organized the symposium, and he chaired the university's Board of Social Service and Religion through which, Mathews told the Rockefeller Foundation, the AISL pamphlets "get into the hands of the student body."12 At around this time, Compton apparently agreed to support the AISL in a further way, by writing a pamphlet to be called, "Why I Do Not Believe in a Mechanistic Universe," but for some reason this did not materialize.13

As this last fact underscores, Compton saw immortality and freedom as part of a single package, so it is hardly surprising that most of his Terry Lectures were devoted to these two topics. I will take the concluding chapter of *The Freedom of Man*, published five years after the Chicago symposium, as his definitive statement on immortality. Multiple drafts of this chapter survive, probably written mostly around 1932 but completed while he was at Oxford in 1934–1935. The original manuscript version was probably written at home, since he used the back of stationery apparently borrowed from his wife—it bears the letterhead of the College Club of Saint Louis, a branch of the American Association of University Women. Compton's clear handwriting is interspersed frequently with individual paragraphs and whole pages cut out of the AISL pamphlet and pasted into the rest. The first twenty-five pages in the published chapter, constituting about three quarters of the whole, overlap substantially



Arthur Compton's own copy of his pamphlet, *Life After Death* (1930), endorsed "Return to A. H. Compton" across the top.

Courtesy of Arthur Holly Compton Personal Papers, University Archives, Department of Special Collections, Washington University Libraries.
with the pamphlet, with about 55% of the text in this section coming directly from the pamphlet. However, the epigram for the published chapter, Jesus' famous words about eternal life in John 14:2-4 ("In my Father's house are many mansions ..."), was apparently written separately, on the back of letterhead from the Ryerson Physical Laboratory. This suggests at least the possibility that Compton was thinking about this biblical passage in his laboratory one day, although it might mean only that he grabbed the closest piece of paper when the idea came to him at home.¹⁴

Regardless of where he wrote it, Compton followed his quotation of Jesus with an unfinished paragraph, originally intended to be the opening lines of the chapter, but later discarded. The hesitation evident in the corrections he made is no less interesting than the incomplete thought that he left unpublished:

It has not of recent years been considered very good form for a man of science to express in scientific certain scientific circles for one a member of the scientific fraternity to express any views whatever regarding religion. This has been <primarily> due, I think, to the fact that [unclear word here, crossed out] science prides itself on dealing with tested truths, whereas many aspects of religion are not subject to the type of tests which can be presented as evidence [ends abruptly in mid-sentence]¹⁵

In the book, after Jesus' words, we find simply the statement that science "has a deep-seated reluctance to present evidence which can only be considered as suggestive. Yet many who profess to speak for science have drawn the definite conclusion that death is the end of all." Mirroring his approach to free will, in this chapter Compton sought only to make room for religious faith, not to offer a knockdown proof of immortality. Science itself could neither confirm nor deny "an aspect of life which is not physical," and thus belief in a future life must "be based upon religious, moral, or philosophical grounds rather than upon scientific reasoning."¹⁶

At this point in his life, Compton's belief in immortality was probably grounded on "good old Cartesian dualism," to borrow the words of his philosopher son – despite the fact that he had expressly rejected dualism in favor of philosophical idealism twenty years earlier.¹⁷ The reality of free will, in his opinion, showed that "there must be at least some thinking possible independent of any corresponding physical change in the brain," so that "consciousness may persist after the brain is destroyed." Scientific evidence points to "a supreme Intelligence, which directs evolution according to some great plan," suggesting the possibility "that the evolutionary process is working toward the development of conscious persons rather than toward the development of a physical organism." If so, then "the whole great drama of evolution" terminates in "the making of persons with free intelligence capable of glimpsing God's purpose in nature and of sharing that purpose."¹⁸ In such a world, he proclaimed,

The thoughts of man, which have come to control to so great an extent the development of life upon this planet, are conceivably to the Lord of Creation among the most important things in the world. From this point of view we might expect nature to preserve at all costs the living souls which it has evolved at such labor. This would mean the immortality of the individual consciousness.¹⁹

If nature could do all this, he concluded, what an "infinite waste" it would be if death were the end.²⁰

This was the shape of the argument for immortality that Compton made in his chapel address at the University of Chicago in 1930 and again at Yale in 1931. As far as I can tell from newspaper accounts and surviving documents, he did not add any biblical arguments to these philosophical and psychological suggestions—he did not even quote the passage in John's Gospel mentioned above, let alone make reference to the resurrection of Jesus. This was a very significant omission for a Christian, but frankly consistent with Compton's lack of belief in a God who can work miracles. "So much for the reasoning of the scientific mind," one traditional Christian responded curtly in the newspapers.²¹

In the published version of the Terry lectures, Compton added five vitally important pages about the Bible that show in stark relief the place where his modernist faith had taken him, five pages that (as the original draft shows) he struggled to phrase precisely. Possibly he penned these as a response, the best he could offer, to those Christians who found the absence of the Bible in his previous statements too glaring. In any event, he described Jesus

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as the first great religious leader "who saw immortality as a necessary consequence of his cardinal principle that God is a loving Father," and he readily admitted that the testimony of Jesus' disciples about the resurrection "made immortality a cardinal doctrine of Christianity," even "an essential element in the vitality of the new religion." This much Compton knew that modern scholarship could not undermine. At the same time, in a scientific age, "this evidence is, however, not such as can carry weight to one who approaches the religion from the outside. The witnesses are gone." Thus, "the bodily resurrection which may then have seemed easy of acceptance, now becomes an impossible barrier to one whose thinking is bound within the limits set by science." There follows then a crucial sentence: "If this is not accepted, what weight can be given to the record of the witnesses?"22

What weight, indeed? For the Christian believer, Compton noted, "personal tests of the Christian doctrines have given confidence in their essential reliability." One senses, however, that he meant the reliability of belief in an afterlife, not the bodily resurrection. Certainly he did not unambiguously affirm miracles, not even the central miracle whose undeniable effect had been in his own words "an essential element" in the life of the early church. He went on to identify two groups of Christians. Some have "such a faith in the Bible's literal accuracy as a revelation that their thinking refuses to remain limited by scientific principles." I cannot believe that Compton saw himself within this group. He can only have belonged to the other group: those who, "having felt the companionship of a God such as Jesus taught, will have gained a confidence in his religious intuitions, and will try to interpret these intuitions as best they may in light of his recorded sayings and of the data of science." Such persons, he concluded, "may see in the principles of Jesus' teaching reason to believe in an immortality of consciousness which is not vetoed by the data of science."23 In the end, Compton had gone as far as his modernist Christian convictions and his views on the limits set by science would allow him to goright up to the door of the empty tomb, but no further.

Compton's overall attitude toward immortality might best be described as one of faith in the midst of doubt—a faith in God that had real practical value. Near the end of World War II, anatomist

B. C. H. Harvey, a fellow member of Hyde Park Baptist Church, asked for advice about how to console the father of a young aviator who had died in battle. "As to a future life," Compton replied, "he knows, as we all do, how the example of bravery, loyalty and other virtues lives on, frequently multiplied many fold, in the lives of those who have come in contact with a noble person." Concerning "the continuation of the individual's consciousness," however, "I find no evidence that is convincing to me one way or the other. I have come to doubt whether it is after all a matter of prime concern, since I find that a good and satisfying life can be lived with either a positive or a negative answer to this question." He was nevertheless "firmly convinced ... that there is a controlling Intelligence working in the world which has a friendly concern for our welfare," and awareness of "the presence of this fatherly God is to me a precious stabilizing influence in these difficult days." Science had only increased his faith "in such an intelligent Power," but it remained "a faith, i.e., it is the proposition on the basis of which I build my attitudes and my life." Such a faith was "a working hypothesis," the "exact form" of which was for him "continually under revision in the effort to make it fit more accurately with my experience."²⁴

In his final years, reflecting in his unpublished autobiography on the "thrilling adventure" that had been his "eventful life," Compton saw himself "making rapid progress toward home, where welcome and rest await me." In language evoking his youthful fascination with airplanes, he wrote that "the short period leading to the landing is the best part of the flight. It is the time when one makes most rapid headway toward his goal. And the vision of the goal itself becomes more clear." His words end in hope: "the restful end of the journey with its welcome at home is greatly to be desired."²⁵

Obviously, not everyone shared Compton's faith. At the original chapel symposium on immortality in 1930, physiologist A. J. Carlson argued against the plausibility of personality surviving after the dissolution of the body.

All the present evidence points to the fact that the nervous system goes to pieces with the rest of the body at death ... I cannot conceive of environments in the future that would exactly reproduce my heredity and personal experience so that I could live again.²⁶

As for the purpose of evolution, a key point in Compton's argument for immortality, Carlson denied that science could know any. "We think we can detect trends in evolution," he said, "but as to purpose, nobody knows. And our wishes in the matter do not change the events." Thus, wishing for immortality "does not make it a fact, though it may render belief in it possible in people with little information in biology."²⁷ One wonders whether he was looking straight at Compton when he uttered that particular point.

He must have been looking at Compton when he delivered a more formal paper that same year on "Science and the Supernatural," as the William Vaughn Moody Lecture at the University of Chicago, which was soon published in Science. When Carlson became president of the American Association for the Advancement of Science (AAAS) in 1944, it was reprinted in the opinion magazine published at that time by the AAAS, The Scientific Monthly.²⁸ Always a forthright person, Carlson began by admitting, "On the topic before us it is preposterous for any man to speak for science as a whole and, by inference, for all scientists." He had nothing new to say, noting the existence of "able works on the conflicts between science and the supernatural," other "attempts at reconciliation of the supernatural with science," printed "confessions of faith in traditional religions by otherwise competent scientists," and "rejections of the supernatural by preachers and teachers of religion." For his part, he offered "the confession of a physiologist of lack of faith in the supernatural, and his reasons." Carlson stressed the importance of "the scientific method," by which he meant "the rejection in toto of all non-observational and non-experimental authority in the field of experience," which he equated with a refined form of common sense.²⁹

Another important factor is "the *attitude* of the scientist" to challenge authority, whether human or divine, coupled with "a serious attempt on the part of the scientist to control his own emotions and his own wishes in the matter." Knowledge excludes faith or belief, and "if he does not know he has no right to faith or belief." The supernatural, on the other hand, involves "events contrary to known processes in nature, such as the production of wine from water alone; the resurrection from the dead of persons in advanced states of decomposition," and several other examples taken from the Bible or

Roman Catholic tradition by the former Lutheran minister. The supernatural "is in direct conflict with science." Surely thinking of Compton and other Protestant modernists, Carlson recognized that "many intelligent people" rejected "the more palpably absurd phases of the supernatural," but in his view

they usually retain a distillate of the super natural in [the] form of beliefs in a "moral purpose" of the universe. And having injected human ethics into an obviously a-moral universe, they endow man with personal immortality.³⁰

The reprinting of Carlson's address did not warm the heart of Compton, who had been AAAS president himself two years earlier, and apparently he sent a letter of concern to F. R. Moulton, the distinguished astronomer who was serving as permanent secretary for the AAAS. Moulton had already received several letters, so he invited Compton to write "a few brief comments," to be published with some of the others in a future issue. Compton thought that "it would be much more worthwhile for me to prepare a rather carefully developed article" in the next few months, but it was not until December 1946 that it was actually published.³¹ Although Compton's heavy involvement with the atom bomb must have been a factor in the delay, he had, in fact, started to work on a reply at the time. His personal papers include what appears to be an early, aborted effort to write the promised article, along with the handwritten outline and typed introduction for an address he gave in Los Angeles in November 1944, which was clearly a forerunner of the essay he sent Moulton two years later.³²

In his published reply, Compton sidestepped Carlson's attack on miracles, which he probably accepted fully. Indeed, he took a standard modernist position on the nature of religion in a scientific age, praising Carlson for the "real service" he had done, "by showing the danger that comes from basing our greatest values on evidence that science cannot accept." In Compton's opinion, "Science requires of religion that the language in which its great truths have been stated," deriving from a prescientific age, must "be translated into a language of verifiable fact." What Compton could not accept was the positivism implicit in Carlson's position, which "denies significance to anything other than physical events, that is, events observable by the senses or measurable by physical instruments."

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Here he believed that "probably most American scientists would part company with Carlson and the positivists." Compton then proceeded to articulate "a scientist's view of the fundamentals of religion," based on "religious sources whose traditional authenticity is unquestionable," starting with his understanding of God.³³

The view of God Compton articulated here, it must be said, was considerably less robust than the one he had put forth in the 1930s. Perhaps this was simply an accident of omission, and I would not want to draw too many conclusions from what he did not say in this place. Nevertheless, this essay put forth a functional rather than an ontological view of God, advancing the type of view favored by Shailer Mathews and others at the University of Chicago Divinity School. Although Compton spoke here of God as "Ruler of the Universe," he fleshed this out only in functional terms, literally comparing the hypothesis of a fatherly God in religion to the hypothesis of the luminiferous ether in physics (I will not digress on the interesting fact that he invoked the ether as late as 1946).

According to Compton, when Jesus prayed, "our Father which art in heaven," he was referring to "the great powers that shape our destinies," assisting "those who work in accord with their laws." This was analogous to the ether. Just as it is hard to think of praying "without imagining a being which gives us the strength," so "it is hard to think of waves without imagining a medium ..." God and the ether alike, he said straightforwardly, "are hypotheses which are fruitful of useful consequences." Probably thinking of Mathews, Compton pointed out that "theologians recognize that the use of the term 'God' is only a convenient name for certain great powers that operate in nature and particularly in man," and that "the concept remains very useful and no other brief description of these powers has proved to be so adequate." He went on to stress the various ways in which the concept of God helped us, by enhancing our ability to love others.³⁴

The bottom line is this: while Carlson had stressed the complete incompatibility of science with any religion based on the "supernatural," Compton saw "no conflict between science and religion," because he defined religion without reference (at least in this case) to the type of "supernatural" events identified by Carlson. Millikan had given functional definitions of both science and religion in a famous statement published in the *New York Times* in 1923, as a way of avoiding conflict, and here Compton offered functional definitions of his own: "Science is a reliable method of finding truth. Religion is the search for a satisfying basis for life." Thus he was able to conclude, "Beyond the nature taught by science is the spirit that gives meaning to life." Faith, hope, and love—a reference to 1 Cor. 13:13—were neither science nor nature, but "the true supernatural."³⁵

Prophet of Science: God and the Atom

It is not hard to understand why Compton took two years to finish his response to Carlson. The atom bomb was dropped on two Japanese cities exactly twelve months after Carlson's article was reprinted. Compton was up to his ears both in the effort to produce it and also in the very intense conversations about the morality of atomic warfare that took place secretly among those who knew about the Manhattan Project. After the defeat of Germany was a foregone conclusion, the original motive for building the bomb-the dreadful fear that the Nazis would build one first-had gone by the wayside. At that point Japan was the only possible target, and it was clear that the Allies were going to win eventually-but at a cost of how many more lives, Allied and Japanese, soldiers and civilians alike? Was the mass killing of noncombatants by a single nuclear explosion any different, in principle, from the firebombings of Dresden or Tokyo? Given the magnitude of the moral dilemma created by this new weapon of mass destruction, the level of Compton's involvement with it, and the strength of his commitment to a religion that many saw as having been founded by a pacifist, the importance of understanding his views on atomic warfare is almost selfevident. However, scholarly literature about the bomb, pacifism, and postwar politics is so extensive, and the amount of archival material relating to Compton's personal activities is so large, that here I cannot give this topic the wide-ranging, thorough treatment that it merits.

One scholar who has studied this carefully, Barton J. Bernstein, shows that Compton wrestled with nuclear warfare more than one might conclude from what he said about it in the partly autobiographical book, Atomic Quest (1956), in which he wrote at length, almost in a matter-of-fact way, about the moral calculus behind his own support for the fateful decision. (Interestingly, the working title for his book-in-progress, "I Chose Atomic Strength," succinctly captures his overall view quite well.³⁶) According to Bernstein, Compton and three other physicists who served as scientific advisers to the government-Italian émigré Enrico Fermi and Ernest O. Lawrence and J. Robert Oppenheimer of Berkeley-all agreed that the bomb should be used on Japan, but within weeks they also agreed, for moral reasons, not to support development of the hydrogen bomb, reversing a recommendation they had made about a month before the Trinity test at Alamogordo. Speaking unofficially for himself, Compton told former Vice President Henry Wallace, an old friend, that the hydrogen bomb "should not be undertaken primarily because we should prefer defeat in war to victory obtained at the expense of the enormous human disaster that would be caused by its determined use." This directly contradicts what he would tell the general public in subsequent years, when he had reconciled himself to thermonuclear weapons as the Soviet military threat loomed ever larger - despite the fact that he continued to believe that the intentional mass killing of noncombatants was immoral. Overall, as Bernstein observes, Compton was "caught in a moral quandary that he had long sought to avoid" and that he did not fully recognize. However, he was not alone in this. The profound moral dilemma "would also ensnare others in the strange new world of nuclear weapons."37

This is all consistent with the recollection of Samuel Allison, who worked directly under Compton on the Manhattan Project, that Compton "felt a gnawing doubt about the morality of the whole effort."38 Compton himself said in 1950 that "I arrived at my decision in this matter only after deep soulsearching and examination of conscience."39 Yet sometimes his public utterances seem much more confident, even self-assured. He framed his overall perspective in a luncheon address he gave in Chicago in December 1952, marking the tenth anniversary of the first sustained chain reaction. "How could peace-loving scientists turn their skill to building such terrible weapons as atomic bombs? The answer is simple. These men found themselves with the power in their hands to stop the most



Arthur Compton in 1948, while he was Chancellor of Washington University.

Photographer: Edward H. Goldberger, Courtesy of Photographic Services Collection, University Archives, Department of Special Collections, Washington University Libraries.

disastrous war in history," and their decision to use the weapon saved millions of lives. "Only one answer was possible to responsible men," he added brusquely, implicitly dismissing the views of many other responsible people. If we had not done this, he believed, we "would have been traitors to mankind" for failing to end the war, just as we would "now be failing our evident duty if we did not give free men" in the postwar world "the means of maintaining their freedom." For his part, Compton was

glad that in God's good wisdom it was the world of free men and not the tyrants who first had these weapons. My hope and prayer is that the free world may retain its atomic advantage until the nations shall have found a way to unite in controlling the use of *all* weapons so that the danger of disastrous war will be gone.⁴⁰

His belief that a world government would accomplish this "within fifty or a hundred years" now seems overly optimistic, but a number of atomic scientists at the time thought it might happen.⁴¹

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In arriving at his position during the war, Compton had considered the Christian pacifism of his Mennonite mother and her family. Two weeks before Hiroshima was vaporized, the army engineer in charge of the massive uranium processing project at Oak Ridge, Tennessee, Colonel Kenneth D. Nichols, asked him what the atomic scientists thought of using the bomb-their opinions had been solicited and competing petitions had been circulated-and what Compton himself thought. At first, Compton hesitated to answer, turning the question back on Nichols, and several years later he recalled having "thoughts of my pacifist Mennonite ancestors" at that moment.42 A few months earlier, Chicago physicist Volney C. Wilson had come to Compton in a vain effort to persuade him not to drop the bomb on Japan. "His reason was the straightforward one of Christian compassion," Compton stated. Wilson, whom Compton described as "a brilliant young Methodist," had originally asked Compton to leave him out of the bomb project, but he changed his mind after Pearl Harbor.43 Compton had also thought about this before America was attacked, when his pastor asked him in 1940, "why I was not supporting his appeal to the young people of our church to take a stand as pacifists." Compton replied as follows:

As long as I am convinced, as I am, that there are values worth more to me than my own life, I cannot in sincerity argue that it is wrong to run the risk of death or to inflict death if necessary in the defense of those values.⁴⁴

His minister promptly dropped the subject.

It was obviously the other half of Compton's family background that won his allegiance on this issue. Elias Compton was a Presbyterian, trained in the Reformed tradition, in which pacifism was relatively uncommon and the dominant view has been that Christians should participate in wars that are fought for morally justifiable reasons, as long as noncombatants are not deliberately targeted. Arthur developed his own version of this theological position in an essay on "The Moral Meaning of the Atomic Bomb," written in 1946 for a committee headed by William Scarlett, the Episcopalian bishop of Missouri. "Human life has its high values," he argued, "because man is a child of God, made in His image and beloved of Him. Man shares with his Father the responsibility for shaping the world and the lives of his fellow men," such that "our highest duty to God is to serve our neighbors." At this point, Compton's uncompromising commitment to human freedom and dignity entered the picture, in a decidedly political form. He wrote,

The true child of God understands and appreciates the things that make a good life, and enjoys working toward such a life for himself and his fellows. Such a person is in the Christian sense free. Promoting for all men such freedom thus becomes to the Christian perhaps the supreme goal of his life.⁴⁵

Therefore it was not simply a political problem, "when a militaristic group usurps the Government of Germany, murders the Jews who seem to be in their way, and starts a military campaign whose evident objective is reducing Europe and eventually perhaps the rest of the world to the status of vassal states ..." It was equally a theological problem. In addition to the traditionally pacifist Mennonites, quite a few modernist Christians from various denominations embraced pacifism after World War I. Compton understood their reluctance to endorse American involvement in another foreign war, and they shared his opinion that war is "an evil, whose elimination is a major goal of Christendom." But freedom itself was too much to sacrifice: without it, life had no value, so war in this case had to be accepted as "the lesser evil."46

Compton did not believe that nuclear weapons had changed the answer. "The morality of the atomic bomb is identical with the morality of war," he stated. In order to force capitulation of the enemy, their industrial capacity must be destroyed, and, in the process, noncombatants will inevitably be killed. Nevertheless, he did think that atomic warfare would make the scope of destruction so large, even for the victor, that he foresaw "the time when we can safely lay our plans on the assumption that wars will not come again." Adding a theological gloss to his political optimism, Compton concluded by comparing our plight today to that of Adam and Eve after they had been expelled from the Garden of Eden and were barred from returning by an angel with a flaming sword. "If we long to return to a pre-atomic age," he said, "the same angel with a fiery sword blocks our path. Atomic power is ours, and who can deny that it was God's will that we should have it?" In struggling to use it for the better, we will get "a growth of the human spirit."⁴⁷

Ernest Lawrence held a similar view, without a theological component, and I wonder whether he may have influenced Compton (or vice versa).⁴⁸

Compton went much further four years later, when The American Magazine published his short essay "God and Atom." After reviewing his reasons for supporting the use of the bomb, he confessed that "God's mercy became very real to me" as "we had to choose the lesser of two great evils." His faith had been a great support, especially prayer. "God understood that what you were doing was the very best that you knew, under extraordinary circumstances," and this realization helped him maintain his "emotional equilibrium. I feel that God recognizes the frailty of man and in His mercy accepts him for companionship despite human mistakes." But Compton did not believe he had made a mistake; God had even participated, in some sense, with the entire Manhattan Project:

I think that not only did God condone our act of dropping the bombs, but that it was only with His help and inspiration that the job was done in time. I consider it a true act of Providence that the ability to make and use atomic bombs first became available to a nation whose primary international concern was a free and stable world.⁴⁹

Recalling the day in December 1942 when Fermi's group had produced the first chain reaction, Compton described it as "a supreme moment of consciousness that I was working with my God and that the outcome of our efforts was a part of His great plan" – an implicit reference to what was apparently his favorite biblical verse, John 5:17. Although the knowledge of fission "had always been available in the basic physical laws that govern the Universe," God, "in His wisdom, had held it back until He thought that in learning to use it, man's stature would grow."⁵⁰

Not surprisingly, these comments hit a lot of raw nerves. Numerous angry letters interspersed with some supportive ones survive among his papers, representing people with a range of religious opinions. A California atheist wanted to know whether Compton was "the witless person who clearly will exhibit your imaginary god to be impotent nuisance, as it must be, if your puny vote was to cause the use of the bomb? And further may I ask, who th'hell do you imagine yourself to be?" A Christian woman from Omaha felt that "promoting work on such an ungodly creation as the atom bomb and recommending its use at any time under any circumstances cannot be reconciled with any religious belief or concern for human brotherhood ... God is no respecter of persons," she admonished him, quoting Rom. 2:11. "The yellow, the red, the black, the brown are as dear to their Creator even as you and I." Another correspondent wanted to know, "Did God give the Italians airplanes from which young Mussolini had the 'sport' of dropping bombs on Ethiopians because the subjection of the Ethiopians was best for a free and stable world?" A friend who worked for The Christian Century found his remarks "both amazing and depressing," scolding him, "How we strut our virtue!" "Christ practiced what he preached," wrote a retired Presbyterian minister, "and He died loving and trying to save the enemies who murdered Him. His principles and practice contradict those of the world. One or the other is wrong."⁵¹ Even from a distance, it is painful to read much of this correspondence.

Prophet of Science: Anti-Semitism and the Social Role of the Christian Church

If Compton's views on the bomb were more pragmatic than prophetic, this did not spill over into his activities for American religion and education in the years surrounding World War II. Consistent with family tradition, for two decades he advised the Laymen's Missionary Movement, at a time when Americans constituted about 40% of all Christian missionaries worldwide.⁵² He also advised the Presbyterian Board of Christian Education, which oversaw the denominational colleges, and many other religious organizations. These roles, which brought him numerous opportunities to address large audiences at conferences and on national radio broadcasts, dovetailed perfectly with his belief in the fundamental importance of altruism.

In the late 1930s, amidst war and rumors of war, Compton believed that religion still had a crucial message for a modern, scientific, and increasingly interdependent society. Science had greatly accelerated social change, giving us new powers to use for good or ill, underscoring the need for cooperation and love for our neighbors. Thus, "the importance of good will among men becomes a matter of unprecedented urgency," and "Christian education

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is the most effective method that we know" for advancing the spirit of love and good will. Within this vision, science and religion were allies: "The growth of civilization under the stimulus of science thus demands the growth of Christian education."⁵³ By advancing our understanding of nature, he said in a Thanksgiving message on the Mutual Broadcasting System in 1939, science has made us "better acquainted with the God of nature, and with the part we have to play in His cosmic drama."⁵⁴ Three years later he told an NBC radio audience what an alternative vision might be like. Where Jesus offered "the surest as well as the most effective means of bringing people to live in the spirit of friendliness toward each other," Adolf Hitler offered

a method more effective than love for getting the active cooperation of his people. This was by stimulating pride of race and nation and hate of all that was foreign. Anti-Jewish and anti-Catholic propaganda, the despising of socalled "weaker" peoples, the dominance of the world by a master race – these reflections of Nietsche's [sic] doctrines he recognized as anti-Christian. They proved remarkably effective.⁵⁵

But hate is destructive, and love is constructive, so hope for a better world remained.

Compton's pointed reference to Hitler's hatred of Jews and Catholics was not simply that of an American shocked by what was happening in Europe. He was no less concerned about religious prejudice at home. From 1938 to 1947, he was Protestant Co-Chairman of the National Conference of Christians and Jews, an important interfaith organization founded in 1927 as a united front to combat bigotry and promote understanding, and he served three terms on its Board of Directors after the war. In this connection, he wrote an article called "The Jews: A Problem or an Asset?" published in October 1941 by the Atlantic Monthly.⁵⁶ This was in response to a two-part article on "The Jewish Problem in America," by the influential libertarian writer Albert Jay Nock, published in the same magazine a few months earlier.⁵⁷ At the same time he appeared on the NBC broadcast of a University of Chicago Round Table discussion of anti-Semitism.58 In both venues, Compton's main concerns were to challenge religious and racial prejudice in the name of democracy and to refute the claim, widespread at the time, that Jews had an undue influence on American foreign policy.



Compton with Broadway actress Katharine Cornell (left) and Austrian-born physicist Lise Meitner (right) on June 6, 1946.

Meitner and Cornell received awards for science and the arts (respectively) from the National Conference of Christians and Jews. These awards recognized women who had contributed to improving human relations and welfare. Compton was Protestant Co-Chairman of the National Conference of Christians and Jews from 1938 to 1947. Meitner had collaborated with Otto Hahn and Fritz Strassmann on the discovery of nuclear fission, but only Hahn was awarded the Nobel Prize for chemistry in 1944. Compton nominated her for the Nobel Prize for physics in 1947, when it was awarded to Edward Victor Appleton. Courtesy of Smithsonian Institution Archives, Science Service Records, 1902–1965 (Record Unit 7091), Image SIA2008-1175.

Another dimension of Compton's extensive interaction with the Jewish community was his relationship with a leading thinker in the Conservative Jewish tradition, Rabbi Louis Finkelstein of the Jewish Theological Seminary in New York. Finkelstein invited Compton to speak about science and religion at the seminary's Institute of Interdenominational Studies, and in November 1938, he spoke there on "The Religion of a Scientist," which the seminary issued as a pamphlet.⁵⁹ A year later, Compton was invited back to help plan the ongoing annual conferences that began in 1940 under the general heading Conference on Science, Philosophy, and Religion in Their Relation to the Democratic Way of Life. Finkelstein and Compton had identical views on the vital importance of both science and religion in a democratic society, and on how science could serve religion.⁶⁰

Six months after the war, Compton was inaugurated as the ninth chancellor of Washington University in St. Louis, a position he relinquished in 1953, although he remained at the university as Distinguished Service Professor of Natural Philosophy and taught a course on science and human responsibility. Regrettably, he did not bring to this assignment the aggressive stance on human brotherhood that he had shown in his involvement with the Jewish community: he dragged his feet on admitting African-Americans to the university and failed to use his authority to advance conversation on campus.⁶¹

With his work on the Manhattan Project, Compton's own research had effectively ceased, but as chancellor he advanced the work of others. He remained very active as a writer, speaker, and advisor to various corporations and organizations right up until his death on March 15, 1962, in Berkeley, where he was lecturing on "Man, Science, and Society." The "almost unique combination" of talents he had brought to his second career as a public intellectual was noted by physicist Alexander Langsdorf Jr., who had contributed a minute quantity of plutonium to the Manhattan Project but strongly opposed the use of the bomb. "His voice was mellifluous, his personality felicitous, and his appearance remarkably handsome and distinguished." Langsdorf's deceased friend had been "a cordial and considerate person, genuinely interested in other people" and "always faithful to the ideas of service to mankind which were a strong tradition of his family and of Wooster College."62

Of course, not everyone appreciated his religious utterances, and it would be a mistake to conflate the high personal regard most of his colleagues had for him into a favorable attitude toward his religion. After a visit to Chicago in 1933, Niels Bohr offered his impression to fellow Danish physicist J. Rud Nielsen. He "spoke highly of Compton as a physicist and a man," Nielsen related not long after Bohr's death, but he was not impressed with his philosophy. "Compton would like to say for God there is no uncertainty principle," Bohr had told Nielsen. "That is nonsense. In physics we do not talk about God but about what we can know. If we are to speak of God we must do so in an entirely different manner."⁶³

As physicist John A. Simpson wrote decades later, the "dualism of the brilliant scientist versus the devout man of the church with his public religiousness was a mystery to many of his contemporaries in the sciences," and sometimes even led Compton's colleagues on the Manhattan Project "to question his leadership."⁶⁴ Indeed, as Samuel Allison pointed out, Compton "was one of the few scientists of stature who could and would address religious groups," and for that reason he was always being invited to do so. It is nevertheless easy to agree with Allison's overall assessment: "There was an intensely religious and idealistic side to his nature, coexisting in a truly remarkable way with his ability to reason in the rigorous and objective manner of physics."⁶⁵

Acknowledgments

I gratefully acknowledge support from the National Science Foundation (SES-9818198) and the John Templeton Foundation (ID# 12389) for the larger project on which this article is based. Conversations with and encouragement from John J. Compton have been extraordinarily important. I am also grateful to Elaine Smith Snyder, Special Collections Associate at The College of Wooster Libraries; Carole Prietto and Sonya Rooney, the former and present University Archivists at Washington University Libraries; and Ms. Rooney's assistant, Miranda Rectenwald. Comments from Michael Day, Arie Leegwater, John Rigden, Jon H. Roberts, Matthew Stanley, Roger H. Stuewer, and Daniel Patrick Thurs have been helpful.

Notes

¹Compton, *The Freedom of Man* (New Haven, CT: Yale University Press, 1935), 140.

²Smith's church membership is reported by Charles Harvey Arnold, *God Before You and Behind You: The Hyde Park Union Church through a Century, 1874–1974* (Chicago: The Hyde Park Union Church, 1974), 230; for information on his career, see Dictionary of American Biography, suppl. 7, 701–2; Theodore C. Denise, "Thomas Vernor Smith, 1890–1964," *Proceedings and Addresses of the American Philosophical Association* 38 (1964–1965): 104–5.

³R. W. Gerard and A. C. Ivy, "Anton Julius Carlson," *Science* 99 (January 21, 1944): 51–2; *Dictionary of Scientific Biography*, vol. 3, 68–70; *Dictionary of American Biography*, suppl. 6, 99–100.

⁴"Religion and the Scientific View of Man," incomplete typescript "Rough Draft," November 6, 1944, Arthur Holly Compton Personal Papers, University Archives, Department of Special Collections, Washington University Libraries, series 6, box 9, folder 17. Further references to this collection are given as AHC Papers. On the Institute and Compton's role there, see "Religious Meet to Draw Noted Scholars Here," *Los Angeles Times*, November 12, 1944, p. 3; "Dr. Compton Say [sic] Religion Has Much to Offer," *Los Angeles Times*, November 16, 1944, p. 10.

⁵The AISL went out of existence in 1944. See Kenneth N. Beck, "The American Institute of Sacred Literature: A His-

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torical Analysis of an Adult Education Institution" (PhD diss., University of Chicago, 1968), and the information accompanying the finding list for the American Institute of Sacred Literature Records, Special Collections Research Center, University of Chicago Library, cited henceforth as AISL Records.

- ⁶Edward B. Davis, "Fundamentalist Cartoons, Modernist Pamphlets, and the Religious Image of Science in the Scopes Era," in *Religion and the Culture of Print in Modern America*, ed. Charles L. Cohen and Paul S. Boyer (Madison, WI: University of Wisconsin Press, 2008), 175–98.
- ⁷Summary report, "American Institute of Sacred Literature," October 25, 1928, Rockefeller Family Archives, Rockefeller Archive Center, Sleepy Hollow, NY, Record Group 2, Office of the Mssrs. Rockefeller, Educational Interests series, box 106, folder 741, "University of Chicago—American Institute of Sacred Literature, 1921–1933." Also see the report for November 14, 1929. Further references to this folder are given as RFA.
- ⁸AHC Papers, series 6, box 9, folder 6. In close proximity with this typescript are two handwritten outlines. These items are interspersed with draft chapters for *The Freedom of Man* (New Haven, CT: Yale University Press, 1935), further evidence of the intimate relationship between immortality and freedom in Compton's mind.
- ^{9"}Immortality from the Point of View of Science," *The Presbyterian Banner* (January 9, 1930): 10–2; "Life After Death: From the Point of View of a Scientist," *The Presbyterian Banner* (March 26, 1931): 10–1 and 14; cf. "A Scientist Considers Immortality," *The Christian: A Liberal Journal of Religion* 7 (March 28, 1931): 310–2. For a later version, partly based on *The Freedom of Man*, see "Why I Believe in Immortality," *This Week*, Easter Sunday supplement to *New Orleans Sunday Item-Tribune*, April 12, 1936, pp. 5 and 12. Compton's address at Wooster is mentioned in "Ohio Presbyterians Meeting in Wooster," *Marion Star*, June 24, 1931, p. 10.
- ¹⁰"Immortality: Four Faculty Men View the Future," *The University of Chicago Magazine* 23 (November 1930): 5–17.
- ¹¹Arthur Holly Compton, Shailer Mathews, and Charles Whitney Gilkey, *Life After Death* (Chicago: American Institute of Sacred Literature, 1930). For information about the print run, see "Statement Concerning Pamphlet Work of the American Institute of Sacred Literature for the Year Ending June 30, 1930," AISL Records, box 11, folder 3.

¹²Shailer Mathews to Arthur W. Packard, November 21, 1930, RFA.

¹³This title is said to be "promised" in the "Statement Concerning Pamphlet Work of the American Institute of Sacred Literature for the Year Ending June 30, 1930," AISL Records, box 11, folder 3. On page 57 of the AISL ledger book for 1930–31 (box 16, folder 1), however, it is listed only as "Requested."

¹⁴The drafts are all from AHC Papers, series 6, box 9, folder 6. ¹⁵"Life Eternal," single handwritten page in AHC Papers, series 6, box 9, folder 6, showing deletions and <insertions>.

¹⁶Compton, *The Freedom of Man*, 120–1.

¹⁷John J. Compton to Edward B. Davis, March 15, 2008. Peter Harrison has recently questioned whether Descartes actually held a strict dualist position; see "That René Descartes Originated the Mind-Body Distinction," in *Galileo Goes to Jail and Other Myths about Science and Religion,* ed. Ronald L. Numbers (Cambridge, MA: Harvard University Press, 2009), 107–14.

¹⁸Compton, *The Freedom of Man*, 129–30 (cf. 133–4) and 139–40.

¹⁹Ibid., 140.

²⁰Ibid., 147.

²¹William T. Ellis, "'Does Death End All?' Rates as Day's Greatest Question," *Huntingdon (PA) Daily News*, February 26, 1932, p. 6. This story was also printed in some other local newspapers, and may have circulated nationally.

²²Compton, *The Freedom of Man*, 149–51. ²³Ibid., 151–2.

- ²⁴Compton to Harvey, February 1, 1945, emphasis his, AHC Papers, series 3, box 5, folder "G–I."
- ²⁵Compton, "Personal Reminiscences," in *The Cosmos of Arthur Holly Compton*, ed. Marjorie Johnston (New York: Alfred A. Knopf, 1967), 3–52, on 52; this anthology is cited henceforth simply as *Cosmos*.
- ²⁶Carlson, in "The Physiologist" part of the symposium, "Immortality: Four Faculty Men View the Future," 13–4. ²⁷Ibid., 14.
- ²⁸Carlson, "Science and the Supernatural," *Science* 73, no. 1887 (February 27, 1931): 217–25; *The Scientific Monthly* 59, no. 2 (August 1944): 85–95; citations are to the latter imprint.
 ²⁹Carlson, "Science and the Supernatural," 85, his italics.

³⁰Ibid., 87–9, his italics. Carlson made several other points, but a full discussion would take us too far away from our subject.

³¹Moulton to Compton, August 1944 (no date, but received by Compton on August 18); Compton to Moulton, September 16, 1944, AHC Papers, series 6, box 9, folder 17. Cf. Moulton to Compton, February 23, 1945. The diverse, highly interesting replies to Carlson's article appeared in the October and November issues.

³²The manuscript outline and incomplete essay of the discarded version are both entitled "Science & the Supernatural," while the outline and introduction for the Los Angeles address are called "Religion & Scientific View of Man." Both in AHC Papers, series 6, box 9, folder 17.

³³Compton, "Science and the Supernatural," *The Scientific Monthly* 63, no. 6 (December 1946): 441–6, quoting 441. Brief comments from two readers were published in the April issue.

³⁴Ibid., 442–3.

³⁵Ibid., 445–6. Millikan's statement was first published in "Deny Science Wars Against Religion, Forty Scientists, Clergymen and Prominent Educators Attack 'Two Erroneous Views,'" *New York Times* (May 27, 1923), p. 1; reprinted in "Science and Religion," *Science* 57, no. 1483 (1 June 1923): 630–1, and several other places.

³⁶Compton to Henry Allen Moe, January 16, 1955, AHC Papers, series 3, box 1A, folder "1955."

- ³⁷Barton J. Bernstein, "Four Physicists and the Bomb: The Early Years, 1945–1950," *Historical Studies in the Physical and Biological Sciences* 18 (1988): 231–63, esp 234–9 and 261–2, quoting Compton's letter to Wallace on 243–4 and Bernstein's assessment on 262.
- ³⁸Samuel K. Allison, "Arthur Holly Compton, Research Physicist," *Science* 138 (November 16, 1962): 794–7, on 796.
 ³⁹Compton, "God and the Atom," *The American Magazine* 150, no. 4 (October 1950): 21 and 117–9, on 21.

⁴⁰Compton, "The Birth of Atomic Energy and Its Human Meaning," in *Cosmos*, 243–57, on 249–51, his italics. ⁴¹Ibid., 256.

⁴²Kenneth D. Nichols, *The Road to Trinity* (New York: William Morrow and Company, 1987), 188–90; Compton, *Atomic Quest* (New York: Oxford University Press, 1956), 246–7.

⁴³Compton, "The Moral Meaning of the Atomic Bomb," in *Toward a Better World*, ed. William Scarlett (Philadelphia: The John C. Winston Company, 1946), 157–74, on 157; *Atomic Quest*, 233 and 41–3.

44Compton, "Personal Reminiscences," 44. I have also drawn on the slightly different version in Atomic Quest, 207-8. Compton did not identify his pastor by name in either place. Family friend James R. Blackwood said it was university chaplain Charles Gilkey; see "Arthur Compton's Atomic Venture," American Presbyterians 66, no. 3 (Fall 1988): 177-93, on 184. John J. Compton concurs with Blackwood. Given Compton's reference to "the young people of our church," however, I think it may have been Gilkey's successor at Hyde Park Union Church, Rolland W. Schloerb, a former army chaplain in World War I who was a staunch pacifist during World War II. Another possibility is the other pastor at Hyde Park, Norris L. Tibbetts, a navy chaplain in World War I who later served as a pastor at the Riverside Church in New York. According to Robert Moats Miller, both Gilkey and Tibbetts favored American intervention in Europe by late 1941; see Miller, Harry Emerson Fosdick: Preacher, Pastor, Prophet (New York: Oxford University Press, 1985), 526.

⁴⁵Compton, "The Moral Meaning of the Atomic Bomb," 161. For helpful comments on Compton's position, see Fred Guyette, "Theological Ethics after Hiroshima: Comparing Arthur Compton and Dale Aukerman," *Didaskalia* 17, no. 1 (Fall 2005): 37–49.

⁴⁶Compton, "The Moral Meaning of the Atomic Bomb," 162-4.

⁴⁷Ibid., 164, 167, and 174.

⁴⁸Bernstein, "Four Physicists and the Bomb," 240.

⁴⁹Compton, "God and the Atom," 118.

⁵⁰Ibid.

⁵¹Lloyd Hermon Brubaker to Compton, September 28, 1950; Stella Dorothea Bremers to Compton, February 17, 1951; Elmer E. Fatrum to Compton, February 4, 1951; Laurel S. Morrison to Compton, September 29, 1950, emphasis hers; H. V. Lela to Compton, October 18, 1950; all in AHC Papers, series 3, box 13, folder "God and the Atom."

⁵²Daniel H. Bays, "The Foreign Missionary Movement in the 19th and early 20th Centuries," nationalhumanitiescenter.org/ tserve/nineteen/nkeyinfo/fmmovementc.htm (accessed February 27, 2008).

 ⁵³"Science, Religion, and a Stable Society," Association of American Colleges Bulletin 26, no. 1 (May 1940): 204–26, quoting 213 and 216. Cf. the pamphlets, Science and Christian Education (Board of Christian Education of the Presbyterian Church in the United States, 1938?), and Telling the Country by Radio, address for Columbia Broadcasting System, October 30, 1938, AHC Papers, series 6, box 3. For another version, see "Science in a War-Stricken World," Vital Speeches of the Day 6, no. 3 (November 15, 1939): 70–2.
 ⁵⁴Compton, "Science and Religion," The Reference Shelf 14, no. 1 (1940): 421–6, on 423. ⁵⁵A Transcript of the Men and Missions Sunday Broadcast over the National Broadcasting Company Network (Laymen's Missionary Movement, 1942?), 4–5, AHC Papers, series 6, box 3.

⁵⁶Compton, "The Jews: A Problem or an Asset?" *Atlantic Monthly* 168 (October 1941): 482–6.

⁵⁷Nock, "The Jewish Problem in America," *Atlantic Monthly* 167 (June 1941): 699–700 and 703, and 168 (July 1941): 68–73 and 75–6. On Nock's thought and anti-Semitic tendencies, see Michael Wreszin, "Albert Jay Nock and the Anarchist Elitist Tradition in America," *American Quarterly* 21, no. 2 (1969): 165–89.

⁵⁸Compton, Robert Redfield, and Louis Wirth, *Anti-Semitism: A Threat to American Unity?* (Chicago: University of Chicago, 1941).

⁵⁹Compton, *The Religion of a Scientist* (New York: Jewish Theological Seminary of America, 1938).

⁶⁰James Gilbert, *Redeeming Culture: American Religion in an Age of Science* (Chicago: University of Chicago Press, 1997), 68–77.

⁶¹Amy M. Pfeiffenberger, "Democracy at Home: The Struggle to Desegregate Washington University in the Postwar Era," *Gateway Heritage* 10, no. 3 (Winter 1989): 15–25.

⁶²Alexander Langsdorf Jr., "Arthur Holly Compton," Bulletin of the Atomic Scientists 18 (September 1962): 28–9.

⁶³J. Rud Nielsen, "Memories of Niels Bohr," *Physics Today* 16, no. 10 (October 1963): 22–30, on 27.

⁶⁴John A. Simpson, "Arthur Holly Compton," in *Remembering the University of Chicago*, ed. Edward Shils (Chicago: The University of Chicago Press, 1991), 69–84, on 82.

⁶⁵Allison, "Arthur Holly Compton, Research Physicist," 796.

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Essay Review

Paul Fayter

On the Lives and Practices of Victorian Scientists: The Case of Joseph Hooker

IMPERIAL NATURE: Joseph Hooker and the Practices of Victorian Science by Jim Endersby. Chicago, IL: University of Chicago Press, 2008. *xii* + 429 pages, including 49 halftone illustrations, 1 line drawing, endnotes, *bibliography, and index. Paperback;* \$35.00. ISBN: 0226207919.

cience, like Christianity, involves the critically reflective interplay of theory and practice. The latter is arguably prior to the former in both domains. And yet, in both scientific and religious matters, the emphasis is usually placed on the former: theories, ideas, doctrines, and dogmas are valued more highly than careful engagement with the material creation (a.k.a. "nature" or "the world"). Orthodoxy trumps orthopraxis. Belief trumps behavior. The end product, whether empirically buttressed theory or theory-laden fact, seems more important than the practical means of getting there.

Surely discipleship—"doing Jesus" is more important than intellectual assent to a series of propositions about what Christians know and believe. Similarly, the social creation and application of natural knowledge and belief – "doing science" – is more important than the production of orthodox bodies of textbook-worthy knowledge.

Of course, I am grossly oversimplifying. In distinguishing between practice and theory, I am perhaps, and incorrectly, implying that it is a question of either/or rather than both/and. The point I wish to make is this: neither faith nor science take place exclusively inside our skulls. Rather, we "do" them by how we live. I am not denigrating theology or theory. But to reduce faith and science to thought is to diminish them both.

How we work out what we believe and think by how we choose to live in the world deserves sustained scholarly attention. This means attention to details discerned in contingent contexts, details not only about the ideas but the actions of particular people located in wider communities and affected by larger cultural currents. Beliefs are embodied in behaviors; the social is expressed in the biographical. The practice of scientific, no less than spiritual disciplines, requires work. Hard work. While this work is done by individuals, rarely is it done in perfect isolation.

For the past three decades, **Paul Fayter** has combined pastoral ministry with academic research and teaching, the latter at the University of Toronto and York University. He was ordained in the United Church of Canada (a historic union of Methodist, Presbyterian, Congregational, and Evangelical United Brethren churches). His teaching has focused on Darwin and Darwinism, history of astronomy and physics, apocalyptic thought, and science, theology, and science fiction. His doctoral work combined theology, ethics, and history of evolutionary biology. He has published extensively in the areas of liturgy, preaching, history of Victorian science and so forth. He is currently working on a PhD thesis on Thomas Huxley and evolutionary ethics at the Institute for the History and Philosophy of Science and Technology. Paul has been a member of the CSCA since 1977.

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And such work involves not only ideas and beliefs, but *things*. In science, these include specimens and museums; in Christianity, such things include fellow creatures, and water, bread, and wine.

At last, we have a first-rate scientific biography of Joseph Dalton Hooker (1817–1911): if not quite a singular, then certainly an aspiring, successful, and significant Victorian gentleman of science. While he lived on the periphery of the Church of England, Hooker worked at the center of imperial British science. For such a key figure – and member of Darwin's inner circle – Hooker has received relatively little attention. This has begun to change.

Once, biographies were the Rodney Dangerfields of the historiography of science (and the historiography of "science and religion," for that matter): they could not get much respect. There were reasons for this judgment; too often such books were poorly researched and written, or too "popular" or hagiographic, or simply juvenile, whether by accident or design. There were fine exceptions, of course. And even bad biography had its benefits; forty years ago, I was launched on a lifetime trajectory after reading, in a public library, a kid-friendly story of Newton's life, work, and thought. But, while simple-minded and even mediocre biographies will no doubt continue to appear, it is no longer the case that biographies of scientists seem like second-rate examples of the historian's craft. Some, like the book under review, are exceptionally well done and - by combining close attention to the fine-grained details of individual lives and practices in their social contexts, with analyses of big ideas and movements, along with insightful portraits of entire ages-continue to redefine the nature of "biography."

Science, we have known for a long time now, is much more than ideas in people's heads. We sometimes forget this, given our gender-biased and over-intellectualized assumptions about science past and present. New generations of historians have, for instance, placed into the foreground the role of scientific "practices" — including the rigors of field work, the formation and nurturing of social networks, the crafting and employment of "scientific" instruments and other artifacts, the creation of laboratory protocols, the proper drawing of inferences from experiments, the recognition of culturally embedded and theory-laden natural facts, the demands of personal, national, and institutional politics to name a few—among other details concerning the acquisition, construction, legitimization, publication, distribution, translation, and transformation of natural knowledge.

Consider, for a moment, the class of subjects that Jim Endersby's Joseph Hooker fits into: nineteenthcentury, English-speaking naturalists whose lives and works illuminate not only nature but the changing natures, practices, and contexts of knowledge; not only nature but concepts of "creation" and evolutionary history; and not only nature but the blurry boundaries between "amateur" and "professional," science and belief, interests and ideas.

Readers of this journal should be aware of the important book-length biographical studies from the past two decades or so that illuminate the abovementioned category of (mostly) men of Victorian science. An incomplete list includes, in chronological order of publication,

- David B. Wilson, *Kelvin and Stokes: A Comparative Study in Victorian Physics* (Adam Hilger, 1987);
- Pietro Corsi, Science and Religion: Baden Powell and the Anglican Debate, 1800–1890 (Cambridge University Press, 1988);
- Menachem Fisch and Simon Schaffer, eds., William Whewell: A Composite Portrait (Oxford University Press, 1991);
- Geoffrey Cantor, *Michael Faraday: Sandemanian and Scientist* (St. Martin's Press, 1991);
- Adrian Desmond and James Moore, *Darwin: The Life of a Tormented Evolutionist* (Michael Joseph, 1991);
- Adrian Desmond, *Huxley: The Devil's Disciple* (Michael Joseph, 1994);
- Nicolaas Rupke, Richard Owen: Victorian Naturalist (Yale University Press, 1994);
- Janet Browne, *Charles Darwin: Voyaging* (Alfred Knopf, 1995);
- Joseph Lester, *E. Ray Lankester and the Making of Modern British Biology*, ed. Peter J. Bowler (British Society for the History of Science, 1995);
- Michael Shortland, ed., *Hugh Miller and the Controversies of Victorian Science* (Oxford University Press, 1996);
- Colin A. Russell, Edward Frankland: Chemistry, Controversy and Conspiracy in Victorian England (Cambridge University Press, 1996);
- Adrian Desmond, *Huxley: Evolution's High Priest* (Michael Joseph, 1997);

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On the Lives and Practices of Victorian Scientists: The Case of Joseph Hooker

- William J. Astore, *Observing God: Thomas Dick, Evangelicalism, and Popular Science in Victorian Britain and America* (Ashgate, 2001);
- Nicholas Wright Gillham, A Life of Sir Francis Galton (Oxford University Press, 2001);
- Janet Browne, Charles Darwin: The Power of Place (Alfred Knopf, 2002);
- Paul White, *Thomas Huxley* (Cambridge University Press, 2003);
- Rebecca Stott, *Darwin and the Barnacle* (Faber and Faber, 2003);
- Frank N. Egerton, *Hewett Cottrell Watson: Victorian Plant Ecologist and Evolutionist* (Ashgate, 2003);
- Ross A. Slotten, *The Heretic in Darwin's Court: The Life of Alfred Russel Wallace* (Columbia University Press, 2004);
- Martin Fichman, An Elusive Victorian: The Evolution of Alfred Russel Wallace (University of Chicago Press, 2004);
- Theodore M. Porter, *Karl Pearson: The Scientific Life in a Statistical Age* (Princeton University Press, 2004);
- Peter Morton, "The Busiest Man in England": Grant Allen and the Writing Trade, 1875–1900 (Palgrave Macmillan, 2005);
- Sandra Herbert, *Charles Darwin, Geologist* (Cornell University Press, 2005);
- Mark Francis, Herbert Spencer and the Invention of Modern Life (Cornell University Press, 2007);
- Linda Lear, *Beatrix Potter: A Life in Nature* (Allen Lane, 2007);
- Michael Taylor, *The Philosophy of Herbert Spencer* (Continuum, 2007);
- Mark Patton, *Science, Politics and Business in the Work of Sir John Lubbock* (Ashgate, 2007);
- Ralph Colp Jr., *Darwin's Illness* (University Press of Florida, 2008);
- Charles H. Smith and George Beccaloni, eds., Natural Selection and Beyond: The Intellectual Legacy of Alfred Russel Wallace (Oxford University Press, 2008); and
- Adrian Desmond and James Moore, Darwin's Sacred Cause: Race, Slavery and the Quest for Human Origins (Allen Lane, 2009).

Special mention should also be made of James Secord's *Victorian Sensation* (University of Chicago Press, 2000), the exhaustive and revealing "biography" of an anonymously written and sensationally received pre-Origin book on evolution; Robert Chambers's notorious Vestiges of the Natural History of Creation (University of Chicago Press, 1994); and Bernard Lightman's Victorian Popularizers of Science (University of Chicago Press, 2007), an equally monumental and groundbreaking study that reconfigures the cultural landscape of post-Darwinian science: its authority, its audience, its relations with religion and morality, and its popularization in mass-produced books written and illustrated by dozens of forgotten women and men, most of whom, contra Darwin's bulldog Thomas Henry Huxley, persisted in seeing nature as designed, purposeful, good, beautiful, and the theater of God's glory. We can additionally look forward to the publication, in a few years, of major studies of John Tyndall (by Bernie Lightman) and Alfred Russel Wallace (by Jim Moore).

Further, as the title Imperial Nature signals, Endersby has situated his study of Hooker in the specific historiography of botany in the context of empire. He builds on such work as Richard Drayton's PhD thesis, "Imperial Science and a Scientific Empire: Kew Gardens and the Uses of Nature, 1772-1903" (Yale University, 1993); David Miller and Peter Reill, eds., Visions of Empire: Voyages, Botany, and Representations of Nature (Cambridge University Press, 1996); and Donal McCracken's Gardens of Empire: Botanical Institutions of the Victorian British Empire (Leicester University Press, 1997). Incidentally, those whose schedules or interests might preclude the reading of a whole book on Hooker are encouraged to read Endersby's 2004 article on him in the Oxford Dictionary of National Biography, easily available in libraries or online for subscribers at www.oxforddnb.com/ view/article/33970.

The grand themes of Victorian science include professionalization, imperialism, and the implications of the sciences, especially of Darwinism, on religious belief. Newer historiography has been dealing with the fine points of scientific practice, knowledge, publication, and reception. Gentlemen of science in important cities, including London, the imperial metropolis, depended not only on field work and libraries but also on networks of correspondents and collectors (including seamen, breeders, and missionaries) who gathered botanical and zoological specimens and transported them from colonial peripheries to imperial centers. Endersby

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focuses on Hooker not only because his life (intrinsically interesting) and work (important) have been under-examined – and thoroughly overshadowed by Darwin's – but because the grand themes were central to his story. With Hooker as his frame, Endersby revises our understanding of those themes.

The professionalization of Victorian sciences, for instance, has been interpreted (most notably by Frank Turner) as, among other things, the attempt by scientists to wrest cultural authority from the Church of England. Francis Galton, the father of eugenics, famously called for a new "scientific priesthood" who would establish naturalism, not Christian theism, as foundational for late nineteenthcentury society. The "professed" or "professional" scientist, Endersby grants, had "quasi-religious" or moral and vocational connotations. But the historical narrative of professionalization, he argues, can be challenged on the grounds that the term itself is not unambiguous, stable, or universally shared; and further, the process looks suspiciously teleological. One of the strengths of Endersby's account of Hooker's botany is its highlighting of some of the complex, and anything but disinterested, negotiations involved in claims for elevating scientific work from "mere occupation" to "respected profession" (pp. 23-7).

Readers of this journal will be most familiar with Hooker as one of Darwin's inner circle of trusted friends. Hooker was the one to whom Darwin wrote (famously, in a letter of 11 January 1844) that "I am almost convinced (quite contrary to opinion I started with) that species are not (it is like confessing a murder) immutable." As Hooker later admitted to Francis Darwin, in notes published in volume two of the latter's Life and Letters of Charles Darwin, he slept in 1839 with proof sheets of Darwin's Journal of Researches under his pillow (acquired via his father, an old friend of the geologist Charles Lyell). Hooker's were the only outside eyes allowed to read the longhand draft of what would become The Origin, the "Essay of 1844." It was Hooker, along with Lyell, who helped a gobsmacked Darwin preserve his scientific priority over the discovery of natural selection, after Darwin received on the morning of 18 June 1858 a package from Wallace in the Dutch East Indies containing a paper describing the same natural explanation for speciation upon which Darwin had for so long been laboring. Hooker, although not without some doubts and disagreements, especially biogeographical, became one of the earliest advocates of Darwinism. Hooker's "Introductory Essay" to his *Flora Tasmaniae* (1860; the introduction was written early in November 1859) was one of the first published endorsements of Darwin's theory, albeit with a few qualifications. And it was Hooker who spoke after Huxley and Bishop Samuel Wilberforce at the infamous 1860 Oxford "debate." These are all well-known stories, and Endersby virtually ignores them all.

There is method in such omissions, however. Endersby is trying to avoid such popular but "wrong" questions as "when did Hooker become a Darwinian?" and "was his support for Darwinism really ambiguous?" He steers the reader away from the pop myth of a "Darwinian Revolution" that instantly made believers of a new generation of younger naturalists. In his concluding chapter, Endersby writes: "The more important question, I would suggest, is 'what made natural selection useful to Hooker?' – not least because this question reminds us that the practices and debates that shaped Hooker also shaped Darwin" (p. 320).

There is very brief mention of Hooker's religious views; he seems to have been a public liberal Anglican and a private agnostic, although not as subversive as his friend Huxley (p. 267). In his 1868 *Presidential Address to the British Association for the Advancement of Science*, Hooker saw religion and science both as routes to truth, able to "work in harmony" as long as the "delusion" of "Natural Theology; a science, falsely so called" was avoided (quoted p. 282).

Hooker earned his MD at Glasgow University where his father William was professor of botany. As so many of his peers did, he embarked on a scientific voyage. As assistant surgeon on HMS Erebus (accompanied by HMS Terror), Hooker spent the years 1839 to 1843 exploring the Antarctic, New Zealand, Tasmania, and the southern seas, collecting plants by the thousands. Upon his return to England, he began preparing his botanical notes for publication (in six large volumes, 1844-1860), he was befriended by Darwin, and he began searching for a salaried position. With the financial support of the British government and of his father (who became the first Director of the Royal Botanic Gardens [RBG], Kew), Hooker was able to mount expeditions to the Himalayas and Bengal. Returning

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in 1851, he was duly appointed deputy to his father at the RBG; when his father died in 1865, Hooker succeeded him as Director at Kew, and so served there until his retirement in 1885. Throughout his career, he continued traveling and publishing and received numerous honors and awards, including being elected President of the Royal Society.

As Endersby writes in his Introduction, Hooker's career "helped define the key issues concerning the status of nineteenth-century science." That is, he was close to Darwin, and "one of his first and most ardent supporters" (p. 5); his work as a world-renowned botanist focused on some of the Empire's vital "natural resources"; he helped create the role of "the modern scientist" who, at a time when prostitution was called a "profession," showed that a paid scientist could also be a respected gentleman, accepted by those whose privileged social status the new scientists hoped also to acquire.

Biography is the domain of the contingent. There was "nothing inevitable" (p. 5) about the paths and changes Hooker followed and helped make. Endersby argues that "there was nothing predictable about Hooker's embrace of Darwinism, which was supposedly the common, secularizing ideology of the scientific professionalizers" (p. 6). Hooker's embrace of Darwinian evolution was, Endersby contends, both more "complex and ambiguous" and less "wholehearted" than previously recognized. His problems with selection theory were not "primarily" religious or political, but arose from the day-to-day "practical difficulties of earning a living from science" (p. 6).

Without neglecting scientific ideas, which he superbly situates in their personal, social, political, and institutional contexts, Endersby constructs a portrait of Victorian science as actually practiced by particular people in particular places, emphasizing the work of discovering, collecting, preserving, storing, and classifying botanical specimens. Endersby connects letters, journals, diaries, and notebooks, not only to finished publications, but also to other material artifacts such as herbarium sheets (dried plant specimens identified and attached to sheets of special paper, filed in floor-to-ceiling wooden cabinets), botanical drawings, and microscopes. Endersby also introduces the questions that Hooker would wrestle with as he sought to understand the relationship between the physical geography of a place-climate,

soils, and so on—and its characteristic vegetation. Hooker wanted to reach beyond description to analysis and explanation: By what natural laws did similar but distinct species succeed one another through time or across space? How and why did species originate and vary? Were there multiple "centres of creation"? How narrowly or widely ought species to be defined? What mathematical tools could be brought to bear in the classification and distribution of plants? "Botanical arithmetic," for instance, made for what Hooker called a "more complete & philosophical" discipline, offering greater precision (as in the physical sciences), which would confer greater authority and prestige to its practitioners.

The tale proceeds both chronologically and thematically. Chapter 1, "Traveling," begins in the summer of 1839 with Hooker accidentally encountering Charles Darwin while walking in London with Robert McCormick, who had served with Darwin aboard HMS Beagle, and who would be the naturalist on the Erebus. In chapter 2, "Collecting," Endersby discusses a Victorian passion that involved far more than plucking plants. Collecting required knowledge: to find the right plants, to anatomize and label parts correctly, and to properly preserve, mount, pack, and transport specimens from colonial outposts to the imperial metropolis. "Corresponding," the third chapter, is a fine addition to the ongoing historical explication of Victorian networks of scientific letter-writing and friendship.

Chapter 4, "Seeing," involves not only seeing with the unaided but educated eye, but also *illustrating* what was observed (sometimes assisted by various instruments), then drawn, painted, or lithographed. This aspect of the naturalist's practice was not only a popular pastime, but also part of scientific training and the commercial publication of what was seen; strangely, photography is not discussed. The Adamic power of naming specimens and species was one means of exerting metropolitan control over colonial collectors. This was a major topic of ongoing discussion between Hooker and Darwin, as Endersby shows in chapter 5, "Classifying."

"Settling," the title of chapter 6, is used in at least two senses: "settling down" after international travel, to secure a salaried position that allowed Hooker to support his wife and family, and the process of authoritatively "settling" disputes, for

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example, between competing systems of classification. Chapter 7, "Publishing," refers to manuals, magazines, handbooks, textbooks, monographs, encyclopedia, and journal articles. Knowledge was written up in various ways for various readers: scientific peers, students, gardeners, and naturalists of all kinds, including amateur ladies and gentlemen. To get into print was to deliberately help to create a new imperial discipline, to enhance personal credibility, and to control an emerging standard nomenclature, among other things.

Chapter 8, "Charting," deals with counting, classifying, and mapping the geographical distribution and migration of species. Certain plants-e.g., the cinchona tree (from the bark of which quinine was made), tea, rubber, and cocoa-had great economic value. Their indigenous management, as well as attempts to transplant them to the UK, reflected botany's imperial character and context. Chapter 9, "Associating," explores the "gentlemanly" and "philosophical" pursuit of natural knowledge. The cut and thrust of scientific debate hinged not only on matters of fact and feeling, but of class, trustworthiness, courtesy, character, and respectability. Uncovering and constructing the origin, definition, and distribution of species was truly social, and not merely intellectual work. Chapter 10, "Governing," is a nice essay on the politics of science. Despite its early private and family roots, the government ownership and funding of Kew Gardens necessarily implicated Hooker in questions of accountability, competition, power, and personality conflict. Kew Gardens was a hybrid institution, both public and private: a center for tasteful education, for healthy recreation, as well as for elite scientific research with global commercial significance. The potential for tension is obvious. The details of how Hooker managed his botanical empire, while building his career, protecting his status, and defending his authority, make for a compelling story.

Endersby begins his "Conclusion" in 1901, when an eighty-four-year-old Sir Joseph Hooker opens a new botanical laboratory in the presence of young white-coated professional scientists who must have regarded the old man as a kind of living fossil. Some of the younger men perhaps understood that Hooker had not only lived through a profound transformation of the sciences, but that he had done much to create it. Professionalization was certainly one part of the great change; Darwinism and "the species question" were others. In his intelligent discussion of Hooker's complex relationship to Darwinism (pp. 316–27), Endersby avoids what he calls the "mythological" errors: (1) that "everything changed" in 1859, and (2) that the big question, or the most important problem for Victorian biologists, concerning species was whether they had evolved. When, exactly, did Hooker first "convert" is—however natural—to ask the wrong question. *Imperial Nature* convincingly asks and answers the more interesting and less mythological question of *how Hooker variously and tactically used natural selection* in different contexts and for different audiences.

[An aside: Endersby asserts that Hooker "was the first man of science to defend natural selection in print" (p. 5). This is true after *The Origin* appeared in November 1859. But, as various scholars have noted, Henry Baker Tristram's "On the Ornithology of Northern Africa. Part III. The Sahara Continued," in *The Ibis*, 1 (October 1859): 415–35, positively applied natural selection theory to the coloration and anatomy of certain lark species (pp. 429–31), using the Darwin-Wallace papers presented to the Linnean Society on 1 July 1858 and published in the *Proceedings* on 20 August 1858.]

The overarching argument of *Imperial Nature* is of far-reaching significance for the history of science: to examine Hooker's ideas without a thorough examination of his travels, field work, instruments, artifacts, and material practices, including collecting and classifying, is "to stand him on his head" (p. 312). Endersby has presented Hooker brilliantly and, if not in full, then at least right side up.

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ECOLOGIES OF GRACE: Environmental Ethics and Christian Theology by Willis Jenkins. New York: Oxford University Press, 2008. 363 pages, index. Hardcover; \$35.00. ISBN: 9780195328516.

Contrary to Lynn White's accusation that salvation stories threaten care for the environment, Jenkins finds in soteriology a powerful incentive for creation care. He proposes a typology of "ecologies of grace" using the classic categories of redemption, sanctification, and deification. These correspond respectively to more commonly termed strategies of eco-justice, stewardship, and eco-spirituality. The three soteriological approaches are more predictive of creation care by Christian groups than the common division into biocentric and anthropocentric. The assumption has been widely held that the more anthropocentric the group, the less care would be offered for creation. Jenkins sees a much more complicated picture in practice.

The Jenkins typology is not a taxonomy. Each representative that he studies in depth (Thomas Aquinas, Karl Barth, and Sergei Bulgakov) fits more than one of his types. This is not surprising in that any theologian in the classic Christian tradition would need to account for all three biblical categories of redemption, sanctification, and deification (or glorification) in their soteriology. The difference between them is in emphasis. Willis notes the contributions and difficulties of each. For example, the stewardship advocated by Karl Barth leaves open the question of whether the human calling as steward is to restore, redeem, or enhance nature entrusted to us.

Willis keeps returning to the question: "Which perspective will best protect and sustain the environment?" It is not clear whether his ultimate intent is to use religion to rally support for already-chosen eco-ends or to live religious conviction better in the crucial area of ecology. At the least, he is sure that pragmatically the two can be mutually reinforcing. "Ecology of grace must make the daily practices of cultivation, preservation, husbandry, hunting, and retreat part of the practices of life with God" (p. 236).

The book reads like a doctoral dissertation with thorough surveys of literature central and tangential to the argument, as well as sixty-nine pages of endnotes. These provide a rich resource for further investigation. To register subtleties, the prose can be convoluted, but this comprehensive treatment is something of a gold mine for those persistent enough to dig deep.

Reviewed by James C. Peterson, R. A. Hope Professor of Theology, Ethics, and Worldview, McMaster University Divinity College and Faculty of Health Sciences, Hamilton, ON L8S 4K1.

HOPE FOR A HEATED PLANET: How Americans Are Fighting Global Warming and Building a Better Future by Robert K. Musil. New Brunswick, NJ: Rutgers University Press, 2009. 224 pages, notes, index. Hardcover; \$24.95. ISBN: 9780813544113.

If, like me, you are concerned about global warming, frustrated with our history of government inaction on this issue, and bewildered as you watch the veritable parade of oversize vehicles continue to roll down our highways, you may be in need of a book entitled *Hope for a Heated Planet: How Americans Are Fighting Global Warming and Building a Better Future.*

One might ask: Are we fighting global warming? Well, at least some Americans are, and it restores hope to hear about them. The primary goal of this book, in fact, is to restore readers' hopes that Americans, world leaders in per capita greenhouse gas emissions, can at last take the lead in drastically reducing them. The book is part political history, part strategy session, and part how-to guide for decreasing our emissions and increasing our political involvement. In a telling reflection of the current status of the climate change problem, this book spends at least fifty pages on rhetoric and politics for every one page on science. Truly, the scientific debate ended at least a decade ago.

The author, Robert Musil, directed the activist group Physicians for Social Responsibility (PSR) for fourteen years, and he takes a public health approach to the issue of preventing climate change. This strategy, and the book itself, encompass several steps. After quantifying the potential adverse effects on human health (and secondarily, on the ecosystems on which we depend), the roots of a problem must be assessed in terms of individual, social, cultural, and political factors. An action plan is then developed based on available resources and experience, and put into effect in order to change behaviors and fix the problem. The author gives this powerful approach (wielded by PSR and allied groups) much of the credit for drastically lowering both the percentage of Americans who smoke and the number of nuclear warheads deployed by the US and Russia. That is an impressive record. Can a public health approach stop global warming, too?

In an especially chilling chapter, Musil looks at the roots of our political impasse, outlining the Washington influence and actions of the "carbon lobby" (consisting of automakers, railroads, power, oil, and mining companies). He gives a first-person account of their work to confuse the public, water down legislation, and stymie international treaties, calling it "a textbook example of corporate greed and disinformation that for far too long outweighed the public good." Musil then presents a spirited, insider's defense of the efforts of a number of allied environmental groups aimed at blunting the anti-environmental onslaughts of the second Bush administration. He concludes that US environmental groups (the available resources) are not yet a match for the well-funded carbon lobby (the roots of the problem), and that the solution to this mismatch lies in better ways of "framing" the problem to convince more people, and politicians, to get on board.

Musil argues that global warming is most compelling when presented as a moral and medical issue, especially when practical solutions are offered. While readers of this journal should be familiar with the moral issue, they may not be aware that global warming is a medical issue: the World Health Organization (WHO) estimates that climate change is already killing 150,000 people per year. Musil describes how climate change impacts the spread of disease and increases the frequency of severe heat waves,

floods, and droughts. He convincingly defends the WHO estimate as a conservative lower limit.

Musil ends by outlining the emergence of a new, politically sophisticated climate movement (that allies with religious groups) and the rapid growth of renewable energy, concluding that "no one can say that we do not have options, working models, and plans that could, given sufficient political impetus and leadership, quickly turn around the US economy and its carbon emissions." The task of preventing climate change continues to grow in urgency, and this book challenges its readers with new ways to get involved. I hope that many will read it and respond.

Reviewed by David De Haan, Associate Professor of Chemistry, University of San Diego, San Diego, CA 92110.



SACRED CELLS? Why Christians Should Support Stem Cell Research by Ted Peters, Karen Lebacqz, and Gaymon Bennett. Lanham, MD: Rowman and Littlefield Publishers, 2008. 272 pages. Hardcover; \$34.95. ISBN: 9780742562882.

The title of this important book will cause some Christians consternation. Surely Christians should not support stem cell research, at least research of the embryonic variety. Surely Christians should object to stem cell research, not act as advocates for it. The authors will have none of this, as they delve into every aspect of the stem cell debate from the perspective of those who have been intimately involved in the ethical debate from its very earliest stages.

This is the second foray Ted Peters has made into this controversial territory, the first occasion being with a much smaller single-author book, *The Stem Cell Debate* (Fortress Press, 2007). Both books emanate from his role as principal investigator on a National Institutes of Health grant to study theological and ethical questions raised by the human genome project, and by his earlier association as an ethicist with Geron. Geron is a California corporation that describes itself as "the world leader in the development of human embryonic stem cell based therapeutics." These experiences have given Peters insight into a host of contemporary bioethical issues.

All three authors have written extensively on theological ethics and are connected with the Center for Theology and the Natural Sciences (CTNS) at the Graduate Theological Union in Berkeley, California. While they represent different theological traditions and have varying stances on some of the issues under discussion, the book is a joint effort with no indication of individual authorship. Their grasp of current scientific issues is impressive. This is no mean feat.

The argument of the book revolves around three ethical frameworks—embryo protection, human protection, and future wholeness. In his earlier book, Peters referred to these as embryo protection, nature protection, and medical benefits. The modified terminology for the second and third signifies a broadening of the perspective, although the underlying thrust of the argument is essentially unchanged. All three frameworks have theological drivers. Each is analyzed in considerable detail, the main exponents of each are identified, and their positions are critiqued. Official Roman Catholicism and many sectors within evangelical Protestantism are identified within an embryo protection framework with its pro-life, antiabortion stance. The President's Council on Bioethics and Leon Kass are seen as major exponents of the human protection position that stresses the dangers of "playing God" and of excessive technological prowess. The authors themselves advocate the third framework, with its emphasis on exploiting possible medical and associated benefits that may accompany stem cell and allied research.

The critique of the frameworks is undertaken against a background provided not only by the political and ethical debates in Washington, but also by the international scene. Nothing escapes the attention of the authors, and particular focus is placed on the stance of the Vatican, a stance that is rigorously dissected.

For the authors, the embryo protection position serves to reiterate the abortion debate. For them this position depends on genomic novelty, constituting as it does the bulwark for indicating the presence of a unique individual, ensoulment, and with it a moral claim based in the will of God. Accompanying this position are closely aligned variants, such as the assertions that it is better to be safe than sorry and that all blastocysts are sacred.

When the debate is based on an embryo protection stance, the ethical principle that comes to the fore is nonmaleficience-of embryos, in this instance. The authors contend that the same applies with the human protection framework, when it is nature (DNA) and culture that require protection. Beneficence only comes into play when emphasis is placed on human flourishing and the vision for a better future. The authors view this possibility in theological terms. For them, humans are called to be created cocreators, possessing the talent for creative transformation. This future-oriented ethic lies at the heart of their positivity toward stem cell research, but they are careful to replace the hype so often surrounding this research with hope-genuine theological hope in the future. They are emphatic in asserting that "the promise of redemption tells us that our future is not restrictively determined by our past" (p. 76).

The authors consider that a central plank of the theological debate is provided by the role of relationality and eschatology in thinking about human dignity. Indeed, one of their criticisms of the Vatican position is that its efforts to find precise connections between ensoulment, individuality, personhood, and protectable dignity force it to surrender its future orientation in exchange for sole reliance on the past. The recently realized totipotency of somatic cells introduces further ethical (and theological) conundrums that, from the authors' perspective, can be addressed by looking to the central significance of relationships rather than intrinsic properties.

This is not a book for the fainthearted, especially for those who do not want their understanding of the embryo to be challenged. The approaches adopted will raise the ire of many Christian commentators, since a raft of cherished "truths" are questioned. However, I welcome this,

since the willingness to confront assumptions and comfortable myths is urgently needed. If this book leads to discussion on such matters as: What is sacred? To whom does dignity apply? How important is good health? it will have served a very useful role in bioethical and theological debate. This will apply even if stem cell research turns out to be less interesting clinically than frequently assumed. Even here though the authors are candid and careful, and refuse to be taken in by the hype of even those scientists with whom they have spent so much time.

Reviewed by D. Gareth Jones, Professor of Anatomy and Structural Biology, University of Otago, Dunedin, New Zealand.



INTRODUCTION TO SCIENCE AND THE SCIENTIFIC METHOD by John L. Campbell. New York: Vantage Press, 2008. 189 pages. Paperback; \$15.00. ISBN: 9780533158355.

Developments in science are frequently communicated through news reports to individuals who vary in their ability to understand and evaluate the validity of these reports. Whereas the American public is reasonably literate in science, many lack knowledge of the scientific method that is often needed to critically evaluate the results of scientific studies. This lack of knowledge was Campbell's primary reason for writing this book.

The author begins with a brief history of science noting the emphasis upon natural philosophy, one of the branches of ancient and medieval philosophy devoted to generating knowledge about nature, until near the end of the nineteenth century. The disciplines of astronomy, physics, chemistry, biology, and the social sciences grew out of natural philosophy and were linked through a shared methodology for generating knowledge-the scientific method. Campbell goes on to distinguish between science's empirical side (observation) and the rational side (reason). In the third chapter on science's rational side, he begins a discussion on the tension between those who want society guided by reason, meaning (to them) science, rather than faith. The author expands upon this tension in the latter part of the book. The section on the history of science would probably be engaging only for highly motivated readers already familiar with much of the content, but interested in nuances and a different perspective on the content.

I was amused that Campbell, an experimental psychologist, assured readers they could skip the chapter on statistical analysis of data without hurting their understanding of science or of the scientific method. His explanation of the use of descriptive and inferential statistical analyses was concise and clear. The author returned to his treatise on the philosophy of science with comparisons of scientific and unscientific views. The first was between the geocentric view advanced by Greek astronomer Ptolemy in a revision of Aristotle's speculation about the earth being the center of the cosmos, and the heliocentric theory touted by Copernicus on the basis of his observations. Readers should find these comparisons of scientific and unscientific views, including creationism and evolution, to be interesting. I sensed that the last three chapters reflected the author's passion to present the strengths and limits of science within a larger context. He decried the actions of social Darwinists and eugenicists in Germany in the mid-twentieth century and in parts of Africa in the late twentieth century, who found promise in ethnic cleansing—genocide. Conversely, Campbell found promise in the Human Genome Project undertaken during the late 1980s and the work in more recent advances, including nanotechnology.

Interestingly, as a believer in the existence of UFOs, the author advocates piecing together a descriptive knowledge about such paranormal phenomena and investigating events that are astounding or incredible. An example of such an event is the worldwide flood described in ancient Jewish and Sumerian legends as well as in the Bible. Campbell is also intrigued with investigating ancient accounts of astounding knowledge such as gold-plated jewelry, a process requiring electricity for electroplating, in Mesopotomia and Egypt dating to 2500 BC. Another phenomenon requiring astounding knowledge was the construction around 1000 BC of 170,000 miles of underground tunnels, some as much as 300 feet beneath the surface, to convey fresh water from relatively wet highlands to relatively arid, more densely populated lowlands, in what now is now southern Iran. Campbell cites theories which purport that extraterrestrial beings, referred to as giants in the Bible (Gen. 6:4 and Num. 13:33), can be credited with sharing the knowledge required for these phenomena.

The author concludes with reflections on science and religion; he discusses various frictions since 1900, not between science and religion, but between humanists, be they scientists or nonscientists, and conservative Christians. He notes that most of these frictions have been in the United States. Campbell proposes guidelines for assumptions and debates that recognize the purview of science and religion and the unique contribution of each.

This book should be of value to individuals interested in science as a social institution and in the intersection between scientific and religious thought. Undergraduate students in the sciences and social sciences would likely respond more positively to books more directly related to their field of interest. For example, a more suitable book for undergraduates in the author's field is *How to Think Straight about Psychology* by Keith E. Stanovich (Allyn and Bacon, 2007).

Reviewed by H. Donald Merrill, Professor of Psychology and Dean of the College of Arts and Sciences, Wingate University, Wingate, NC 28174.



THE HIV AND AIDS BIBLE: Selected Essays by Musa Wenkosi Dube. Chicago, IL: University of Scranton Press, 2008. Paperback; \$20.00. 208 pages. ISBN: 1589661141.

This book is an essay collection written by Musa Wenkosi Dube, a professor of New Testament Studies at the University of Botswana. Dube wrote a series of essays from 2001–2003 which provided the foundation for her thoughts as a theological consultant for churches in Africa. In particular, Dube has been a consultant for the World Council of Churches regarding the theological issues surrounding Human Immunodeficiency Virus (HIV) and its resultant disease (Acquired Immunodeficiency Syndrome or AIDS) in Africa.

The book is divided into four sections. Part One (Theological Education in the HIV and AIDS Struggle) provides the background of Dube's personal journey in deciding how to address the theological issues raised by HIV/AIDS. She recounts a sentinel aspect of her life when she gave a paper (Preaching to the Converted: Unsettling the Christian Church) to the World Council of Churches that brought up significant discrepancies between the message of churches and the spread of HIV/AIDS on the African continent. She also discusses why Christian churches in Africa tend to avoid a discussion about HIV/AIDS, especially as it relates both to women and to those populations in extreme poverty.

Part Two (Biblical Studies in the HIV and AIDS Struggle) attempts to apply theological teaching to Bible scholars and lay persons who deal with the presence of HIV/AIDS as part of daily life in Africa, especially in the context of Jesus' miracles of healing. She discusses how the Bible should be taught knowing that a large population hearing the Word will be either infected or exposed to HIV. Some detail is provided as to how to incorporate the HIV/AIDS epidemic into Bible studies, including the historical, literary, and social science aspects, but only a paucity of ideas are provided. A chapter in this section emphasizing Christ's raising of Jarius' daughter from the dead in the Gospel of Mark provides a simple and effective example of how a Christian perspective on HIV/AIDS infection in Africa can be prescribed. There is both a unique feminism and postcolonial aspect to this Gospel, especially relating to the aspects of Jesus traveling to the home of Jarius. Dube also discusses various other social epidemics co-involved in the HIV/AIDS epidemic, including poverty, gender discrimination, social injustice, and racism.

Part Three (The Gospel and Christology of the HIV and AIDS Struggle) addresses how HIV/AIDS should be looked at by church leaders. Dube points out that as members of the Body of Christ, if one has AIDS, we all have AIDS. Using Luke 4:16–22 as a metaphor, the author states that just as Christ was sent to restore the sight of the blind and to free the oppressed, churches should attempt to heal the more difficult aspects of HIV/AIDS, such as addressing poverty and being direct about sexual transmission of this disease and its prevention (including rape and prostitution). Jesus, if asked, would certainly forgive the sins of the most sinful sex offender. Dube points out that Christians should do likewise. Using the Setswana word "kutlwelobotlhoko" or compassion, she further points out that compassion requires action, as we must address the spread of this disease that has killed millions of people and orphaned millions of children in Africa.

Part Four (Ethics and Hope in the HIV and AIDS Struggle) details how to address moral and ethical issues regarding HIV/AIDS prevention in the setting of African churches. In particular, although moral guidance is given by Christian leaders, more emphasis should be made on removing the stigma of infection, as well as openly

discussing prevention. Dube believes that a change should be made in order to develop a more "listening and supporting church" for the vulnerable population groups in Africa (women, children, the impoverished, etc.).

I think this book has the potential to bring about powerful arguments as to how Christians should discuss HIV/AIDS and how they need to be more accepting of those people infected or at risk of the disease. As this epidemic continues to spread worldwide—in China and Russia, and especially in African countries—it is imperative for the body of Christ to face the seemingly uncomfortable aspects of HIV/AIDS (prostitution, rape, condom use). These aspects should be openly discussed within the context of morality and Christ-like love. Indeed, a societal effort, not just from the medical community, is needed to halt the progression of the HIV/AIDS epidemic. I wholeheartedly agree with Dube on this point.

However, this book's poor organization makes the message less than clear. Although the book consists of a series of essays, future editions would probably be improved if there were a short introduction at the beginning of each chapter, providing the context in which the essay was written. Also, although the author provides a good overview of how to present a Christian message in the setting of HIV/AIDS in Africa, the book would have been better if more "real world" examples (such as lesson plans or class note outlines) were provided to help begin an open conversation about HIV/AIDS, both in the academic classroom and among the lay population. This book's message is too important to be lost in poor organization.

Reviewed by John F. Pohl, Associate Professor of Pediatrics, Scott and White Hospital, Texas A&M Health Sciences Center, Temple, TX 76508.

A TANGLED WEB: Medicine and Theology in Dialogue by R. John Elford and D. Gareth Jones, eds. Oxford: Peter Lang, 2008. 279 pages, general index, name index. Paperback; \$72.95. ISBN: 9783039115419.

Half of this book was written directly by our own ASA Fellow D. Gareth Jones. The collection is the result of a colloquium, at which six theologians responded to Jones' ethical reflection on four cases. Jones describes himself "as a scientist working within the Christian tradition." In this anthology he is literally surrounded.

The book is organized in three parts: theological background, specific cases to consider, and theology in the sphere of public policy. In the first essay, Gerard Mannion argues that moral discernment is best carried out in broad communities. John Elford follows with the idea that love is the fundamental motif of specifically Christian ethics, but that "biblical faith is ever in the making." Then, Adam Hood emphasizes that theology does not define the good, tell us what we must do, or make judgments based on metaphysics. What it does do is help us to see the ethical dimensions in the situations that we face. The theme prominent in all three essays is that theological insight should enrich society-wide dialogue.

Part Two centers on Jones' description and prescription for four cases. The first is the tragedy and damage wrought when fraud occurs in the practice of science or

theology. When a theologian or scientist overstates or misdirects, to his or her own temporary benefit, the effect is devastating both for the perpetrator and for the discipline. Neither science nor theology should claim more than they can actually accomplish in interpreting their data. The second essay asks whether plastinated displays of posed human bodies are more akin to educational dissection or to mere entertainment. The former could be justified as sufficiently respectful, the latter could not. The third case argues that the ethics of genetic intervention have often been presented in a false dichotomy. We are told that we must either transform humanity into a new species or ban intervention all together. Jones argues that actually we are already enhanced, compared to earlier generations, and that such is good. Thoughtful extension of ability can be welcomed without seeking radical transformation. The fourth essay rejects that prenatal genetic diagnosis (PGD) is inherently eugenicist, but warns against slipping into an attitude of sacrificing the weak to benefit the strong.

The essays of Part Three advocate a place for theological voices in the UK's national regulation of *in vitro* fertilization and PGD. Then John Elford concludes that theology helps to identify the issues at stake in scientific practice, and it can offer moral theories needed to address those issues. In this book, the theologians emphasize the need for a process that allows space for theological critique. It is primarily the scientist Jones who mulls through specific ethical issues. Jones says that his goal in the colloquium and the book is to foster vigorous dialogue between theologians and scientists, each respecting the other's expertise and contribution. Respect is evident throughout. Critical interaction between Jones and his theological interlocutors is more advocated than carried out.

The book's price indicates that it is aimed at libraries rather than individuals. Libraries that support the ongoing interaction of human biology and Christian theology would do well to purchase a copy. This would be particularly important for readers who may not be aware of the perspectives and insight of the English-speaking discussion beyond America's borders.

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SPIRITUAL DIMENSIONS OF NURSING PRACTICE by Verna Benner Carson and Harold G. Koenig, eds. 2d ed. West Conshohocken, PA: Templeton Foundation Press, 2008. 403 pages, notes, index. Paperback; \$34.95. ISBN: 9781599471457.

The editors of *Spiritual Dimensions of Nursing Practice* set forth three goals for the second edition of this manuscript. These goals are essentially identical to those of the first edition and include focusing on (1) the universality of spirituality, (2) spiritual care as integral to the provision of nursing care and all health care, and (3) demystifying the concept of spiritual care and spiritual needs. Nurses are identified as the primary audience of this book. However, the editors suggest that the book's applicability extends to practitioners and students alike, in both nursing and the allied health disciplines.

The book is organized into four distinct sections. The first section explores spirituality and the nursing profession. Spirituality is defined as an abstract multifaceted concept affected by personal experience, religion, culture, and worldview. The characteristics of and risk factors for spiritual distress are outlined. An overview of the research linking religion and health is presented as well as mechanisms by which religion may positively influence mental and physical health outcomes. Section two examines the relationships between theistic and eastern pantheistic religious groups and health care. Specific beliefs and practices that may affect the planning and delivery of health care are explored. A chapter on legal issues outlines constitutional guarantees, evolving law, and policy constituting the basis for state, client, and provider arguments for religious freedom in healthcare decision making. The third and largest section of the text fleshes out the specifics of spiritual care. It provides a framework for spiritual assessment and suggests three types of spiritual interventions including the ministries of presence, word, and action. From there, we journey across the lifespan. The authors explore spiritual care for children and adolescents, as implemented in the context of developmental stages and family relationships, as well as a conceptual model for spiritual coping which can be applied to adults with chronic illnesses. Love is presented as a theme to explore spirituality with older adults. A discussion of the multifaceted needs and spiritual interventions for the dying and their families completes this section. The fourth section explores the possibility of creative partnerships between faith communities and healthcare providers for the purpose of multiplying scarce healthcare resources. From there, a discussion of ethical decision making and spirituality ensues. Teleological and deontological theories, as well as the ethical principles of beneficence, autonomy, nonmaleficence, and justice, are presented as tools for the resolution of dilemmas as demonstrated by their application to five precedent-setting cases. The final conversation pertains to the salient issue of meeting the spiritual needs of nurses in both educational and work settings.

Spiritual Dimensions of Nursing Practice provides a comprehensive discussion of the topic of spiritual care that is accessible to the practitioner and student alike. Carson and Koenig take the abstract concept of spiritual care and demonstrate how it can be seamlessly integrated into the care of persons and their families. Throughout the text, the reader is encouraged to engage further with the topics presented via interesting quotes, case studies, and reflective activities. Relevant bibliographic citations at the end of each chapter allow the reader to connect with the broader literature in the field. Linking the discussion to the existing evidence base (chap. 2, "Religion, Spirituality and Health") and suggesting a conceptual model of religious and spiritual coping (chap. 8, "Adult Spirituality for Persons with Chronic Illness") is particularly helpful, as it grounds spiritual care in the science of the discipline of nursing. The chapter addressing potential areas of collaboration between faith groups and healthcare providers for the purpose of providing health services is especially timely in light of the current economic climate, when so many are without adequate access to health care. While Carson and Koenig's manuscript bears some resemblance to Mary Elizabeth

O'Brien's *Spirituality in Nursing: Standing on Holy Ground* (2003), this manuscript extends the conversation begun there in useful ways.

The chapter on ethical decision making seems incomplete. While an initial linkage between spirituality and ethical decision making is asserted by the statement ... spiritual issues are inextricably interwoven with the kinds of ethical decisions that confront health care professionals and those for whom they care" (p. 331), this linkage could be more fully explicated. Might it be one's conceptualization of person, beliefs about the purpose of health, or definition of nursing practice that introduce spiritual issues into specific ethical dilemmas? Further, the ethical theories and principles are applied to precedent-setting cases rather than to the daily ethical dilemmas that nurses encounter in their practice. Such an approach distances this important topic from the everyday experience of the nurse, and does not address the question of how necessary support can be provided to these point-of-care practitioners.

The second edition of *Spiritual Dimensions of Nursing Practice* is a timely update that fulfills its specified goals. This book constitutes an excellent addition to the nursing and allied health literature.

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PLATO'S GHOST: The Modernist Transformation of Mathematics by Jeremy Gray. Princeton, NJ: Princeton University Press, 2008. 515 pages, glossary, bibliography, index. Hardcover; \$45.00. ISBN: 9780691136103.

"Modernism," like its younger cousin "postmodernism," is one of those squirmy weasel-words that is difficult to pin down long enough to gain a clear and cogent view of its meaning and referents. Perhaps these terms are best used to describe whole families of attitudes and beliefs. Nevertheless, historians and critics have felt comfortable applying them to specific trends in the visual arts, architecture, literature, poetry, drama, film, music, theology, and philosophy. Modernism, in this sense, is often pegged to certain developments around the turn of the twentieth century, especially in the arts. But what about science and mathematics? Are there substantial modernist trends in these fields? In *Plato's Ghost*, the distinguished historian of mathematics Jeremy Gray investigates this possibility for mathematics.

A "core definition of modernism" is offered at the outset of the book: it is that "cultural shift" occurring between 1890 and 1930 which makes mathematics

an autonomous body of ideas, having little or no outward reference, placing considerable emphasis on formal aspects of the work and maintaining a complicated—indeed anxious—rather than a naive relationship with the day-to-day world, which is the de facto view of a coherent group of people, such as a professional or discipline-based group that has a high sense of the seriousness and value of what it is trying to achieve.

This captures much of what Gray intends with the word, but he fleshes it out a bit further for mathematics. For him, modernism is a shift in professional mathematicians' philosophical perspective that embraces an abstract ontology and an epistemology that nearly dissolves into logic. The main conditions imposed on theorizing by modernist mathematicians are those of the formal axiomatic method – concepts must be logically consistent and results rigorously derived, but otherwise mathematical creation is completely free.

This outlook certainly typifies many foundational developments in mathematics around 1900, but Gray argues that it is characteristic of mathematical practice more broadly and that viewing this time period through the lens of modernism unifies a number of aspects of mathematics.

After an introductory chapter delineating his thesis in general terms, Gray divides his story into three main parts: (1) a pre-modern period (the nineteenth century prior to about 1890, though he identifies Riemann and Dedekind as mid-century precursors), (2) a period in which modernism emerges, and (3) a time in which its outlook has become the accepted orthodoxy of professional mathematicians. The final three chapters are devoted to issues more on the periphery of mathematics (its relation to physics, attempts at popularization and writing its history, and its relation to language and psychology) and to some further mainstream developments between the two world wars. Within each main time period Gray follows a topical organization, looking at developments in four main fields: geometry, analysis, algebra, and logic/set theory/foundations.

From his past work, Gray is very conversant with developments in geometry and analysis, and his treatment of these topics is authoritative and informative. Modernism in geometry is associated with changing views on the nature of and developments within geometry (non-Euclidean geometry, projective geometry, Hilbert's axiomatization of elementary geometry, Italian axiomatic geometry) as well as on geometry's relation to science and everyday experience. In the field of analysis, Gray distinguishes between early foundational efforts (Cauchy's arithmetization, Weierstrass's rigorization) and later more abstract developments in analyzing the nature and meaning of numbers (Dedekind on real numbers and natural numbers).

Gray also points out modernist developments in algebra and the foundational fields of logic and set theory. Algebra moved from more concrete concerns in solving equations and finding regularities within number theory to maneuvers of inventing new types of numbers for various tasks (ideal numbers, quaternions, p-adic numbers). In the twentieth century, modernism becomes entrenched in algebra with the structuralist approaches of Emmy Noether and Bourbaki.

In the case of logic, two decades after an 1820s revival in Great Britain of traditional modes of deduction, the field was transformed by Boole and others into a branch of algebra. It was later extended to include relations,

quantifiers, and mathematical symbolism, and its relation to mathematics was inverted and refined by Frege and Russell. In the early twentieth century under Hilbert's influence, logic became the tool of metamathematics, whose concern was the analysis of axiomatic theories for consistency, completeness, and independence, becoming aligned in the end with set theory and abstract model theory. Promoting set theory as the ultimate foundation for mathematics provided the discipline with a self-contained modernist ontology. In discussing these developments, Gray tends to rely more on other authorities than on his own work, but foundational aspects are probably the best-known part of the story he is telling.

Even applied areas of mathematics felt the drift toward modernism. This helps us understand why Eugene Wigner, a leading physicist, would write in 1960 about "The Unreasonable Effectiveness of Mathematics in the Natural Sciences" as being a mysterious business. As Gray notes, mathematical physics had given way first to applied mathematics and then to mathematical modeling, in keeping with the modernist trend of loosening the ties between mathematics and empirical reality.

The book's strength lies in its treatment of the various mathematical developments – mathematical practice – during this period. Occasionally, this is also its weakness; at times, the reader needs help in seeing the contours of the forest for the clutter of the trees. Mathematical technicalities are kept to a minimum, but the number of thinkers treated and the epic range of topics taken up can overwhelm those unfamiliar with them. Moreover, readers interested mostly in the mathematics may be tempted to skip over some of the philosophical and psychological portions, which would have benefitted from being more concisely analyzed and summarized. The exposition invariably improves when Gray steps back to assess the importance of a topic to his overall thesis.

Plato's Ghost makes a strong case for there being a modernist transformation in mathematics. While Gray obviously takes modernism in the arts as encouragement for postulating his thesis for mathematics, he consciously does not connect the two phenomena in any direct sense. He notes similar general trends (increased professionalization, autonomy and independence from other fields, emphasis on formal elements, cultural anxiety, and so forth) and speculates that these may arise from parallel contexts and concerns ("convergent evolution"), but he declines to demonstrate a common source. This puts his thesis on safer ground, but it will also make it less satisfying for many readers. In the end we are left wondering, why were there similar trends at this time in both fields? And some of us would undoubtedly like to know, how do these trends relate to other contemporaneous modernist developments, such as in theology? Can we dig down below the surface to find any common motivation, any shared zeitgeist?

I also would have liked to have seen some analysis of how the trend of modernism relates to earlier and broader developments in philosophy and worldview. The strong underlying tendency of modernism to overthrow authority and norms (freedom from God and the church, emancipation from the tyranny of monarchs, rejection of tradition) can be clearly seen both in Enlightenment philosophy and revolutionary politics, and this has even deeper roots in early modern thought where assertion of human autonomy arises as a major theme. Are twentieth-century developments a radical departure from these earlier developments, a genuine paradigm shift, as Gray asserts, or are they an intensification of aspects of the same humanist spirit? Modernism's historical lineage ought to be traced further back than Gray does in *Plato's Ghost*, to give us a more long-term perspective on what is brand new and what might develop core tendencies that had already become prominent when "modernism" was first self-consciously proclaimed by mid-eighteenth-century thinkers. This may be asking for more than can be comfortably proved in scientific or historical terms, but readers of these pages will likely acknowledge a responsibility to test the spirits, in intellectual affairs as well as in spiritual and moral matters.

What we have here, then, is an excellent and detailed survey of how modernism took root in mathematics. *Plato's Ghost* provides the launching pad for future ruminations on the modernist thesis. At the same time, I think it begs for extension, both backward to root the phenomenon more firmly in history, and forward into our present time, when modernism is no longer as prominent or as tightly held as it was a century ago.

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THE BIG QUESTIONS IN SCIENCE AND RELIGION by Keith Ward. West Conshohocken, PA: Templeton Foundation Press, 2008. 272 pages, references, index. Paperback; \$16.95. ISBN: 9781599471358.

In the 1940s radio quiz show Twenty Questions, the host started each game by letting everyone know that he held a secret belonging to a single category: animal, vegetable, or mineral. The contestants would then try to discover the secret by posing as few yes-or-no questions as possible. The best strategy was always an eliminative one. A good question-especially early in the game-was one that ruled out whole ranges of categorical possibility. Anyone reading Keith Ward's Big Questions should recognize from the outset that he is not playing a quiz show game. The table of contents does list twenty questions about science and religion, but these are not requests for categorical specifications about something or someone that we might uncover. His reflections on these questions widen rather than narrow the range of possibilities that one should consider.

The big questions are perennial ones in philosophical theology. They deal with cosmic origins and endings, creation and evolution, laws and miracles, matter and spirit, nature and norms, and divinity and revelation. As priest, philosopher, and "lover of science," Ward seeks to keep these questions alive, arguing repeatedly that while science may alter the ways in which they are asked, it can neither dismiss them nor provide the final answers. The core message is that

Science will not resolve these deep existential struggles. But science can help to dispel ignorance

about the universe and bring some clarity about the relation of the objective Supreme Value postulated by religion to the observed nature of the physical universe. It may even help to clarify the nature and possible purposes of a being of supreme value.

The preceding quote provides an example of the book's erudite tone and offers a glimpse into its intellectual framework. Ward is a recognized Christian theologian and leader in interfaith discussions. His knowledgeable reflections on different religions are perhaps a distinctive contribution to the science-and-religion dialogue, for they expand beyond the traditional, Western understandings that have dominated the dialogue. However, with respect to science, he admits to being a spectator and claims to take scientific discoveries at face value. This "view from a distance" lets Ward describe how such discoveries might fit into or alter the broad conceptual landscape of religion, but it prevents him seeing the inner workings of science.

Thus, the big questions here actually might not be *in* science at all, and therefore not in science *and* religion. What makes questions "big" is a context of religious concerns. But what if science is independent of such concerns? Is it then impermeable to the big questions? Ward seems to allow that it might be so, in which case a better title for his book might be *The Big Religious Questions with Which Science Has Little to Do.* If this is indeed what he intended, he could have served his readers better by opening the discussion as a quiz show host might—with a categorical clarification that starts things off on a clear track.

The book's actual title (as well as its genre) trades on a latent demarcation problem that remains unresolved in much of the science-religion dialogue. Different parts of the discussion draw upon various essentialist assumptions about science, assumptions requiring the existence (though not the specification) of criteria according to which science can be distinguished from other forms of inquiry. Despite a growing consensus that such criteria might not actually exist, books like this succeed without asking the (big?) question of how the dialogue might go if essentialist assumptions were abandoned. Ward's essentialist demarcations are not drawn clearly or consistently. But the language of division crops up, for example, at the end of the third chapter:

Claims on both the religious and scientific sides to give an all-encompassing and exclusive view of truth will bring religion and science into conflict. A more tentative search for the spiritual meaning of ancient scriptures and for the methodological fruitfulness of biological research programs offers the prospect of a more positive and creative interaction, the results of which cannot be laid down in advance.

In my reading, Ward employs the fact-value distinction as a surrogate for the unresolved science-religion demarcation, and he thereby ignores one of the bigger philosophical questions of the last century (i.e., whether this is a legitimate distinction). Facts about the physical world belong to science, whereas Supreme Value or Spirit is the concern of religion. The book's unexplained profusion of capitalized spirit- and value-related terms seems intended to evoke the crystallization of a "domain-of-religion" concept. Moreover, the absence of any serious consideration of science as an interpretive, value-laden practice does nothing to dissuade the reader of the view that science simply tells the unambiguous truth about the material world.

Ward's uncritical acceptance of popular conceptions of science is the book's biggest weakness. It prevents him from offering what could be useful criticism but does not stop him from making seemingly inconsistent statements about scientific endeavors, as when he at first makes and then later retracts the claim, "Science works on the assumption that every event has a cause." Most importantly, it renders him unable to shake the idea that, since religion has concerns that science cannot touch, so also science has concerns that religion cannot touch. The alternative would be an idea that scientific endeavors are always shot through with (a plurality of) religious concerns and never impermeable to them.

Nevertheless, within each chapter of the book, Ward's provisional working assumptions about science feed into a rich and probing discourse on alternative religious philosophies, and on the general refusal of religious concern to be circumscribed by scientific understanding. Popular science is really just a springboard here; the questions emerge from it but are not offered as part of a scientific discussion. Perhaps vagueness or inconsistency does not hurt if it is used just to get a round of conversation started. But when this book is read as a whole, or when its chapters are read against each other, a question can be raised about its underdeveloped understanding of science. This would seem to be a big question, since it somehow has to fit into the category that our host has in mind for us-that is, into religion, perhaps the broadest category with which we might be concerned.

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WHEN GOD GOES TO STARBUCKS: A Guide to Everyday Apologetics by Paul Copan. Grand Rapids, MI: Baker Books, 2008. 221 pages. Paperback; \$14.99. ISBN: 9780801067433.

A real pleasure in life is to gather with friends and discuss the cultural hot topics of the day. These conversations can challenge what one believes. In the enjoyable *When God Goes to Starbucks*, Paul Copan "guides readers, Christian or not, into practical answers to tough questions and hard-to-handle slogans." The reader gains approaches and information that can help to engage in robust conversation.

Each chapter states issues at the beginning and then lists multiple points to consider. Each of these ideas is expanded and justified in order to provide the reader with the resources to increase understanding of the subject. At the end of the chapter the main ideas are then again restated. This structure is one of the few things that I would criticize about the book. By the fourth or fifth chapter, it was clear that the chapter summary was redundant when Copan had again already done a commendable job of explaining each point.

Copan offers three main sections. The first addresses questions about reality, the second about worldview, and the third about how Christianity relates to the world. Section one is entitled "Slogans Related to Truth and Reality." It works through various specific phrases such

as "looking out for number one," "whatever you do is fine as long as no one gets hurt," and lastly, "when is it OK to lie." Section two looks at truths about God, miracles, and homosexuality. In the three chapters in which Copan talks about homosexuality, I found him balanced and compassionate. At the beginning of the first of the three chapters, he states,

All too often "Bible-Believing Christians" can act with a smug moral superiority toward homosexuals rather than extending friendship and Christ-like love to them. Let me say that I have a great appreciation and respect for the homosexuals I know, and I don't write this to "attack." However, this is an important issue—one that is often insensitively handled ... (P. 78)

This irenic approach is characteristic of the book. In the last section, "Slogans related to Christianity," he primarily deals with two issues: the comparison of the biblical holy wars to Islamic jihad, and the second coming of Christ.

All in all I found this to be a very readable book that provides a good set of responses to challenging topics that commonly come up over a cup of coffee.

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GOD INTERRUPTED: Heresy and the European Imagination between the World Wars by Benjamin Lazier. Princeton, NJ: Princeton University Press, 2008. 254 pages. Hardcover; \$29.95. ISBN: 9780691136707.

God Interrupted is, on the surface, a narrow monograph on a small slice of theological history. The thesis of the book is that between the World Wars there was an important theological attraction to two heretical alternatives to traditional monotheism—Gnosticism, in which God is wholly other, and Pantheism, in which God is identical to the world. Karl Barth's popular crisis theology represents the former and the renewed theological interest in Baruch Spinoza's thought represents the latter. The book's particular focus is on three German-Jewish thinkers—Hans Jonas, Leo Strauss, and Gershom Scholem—each of whom attempts to address these heresies.

The book, Lazier's reworking of his doctoral dissertation, is divided into three sections: "Overcoming Gnosticism" traces Jonas's theological thought; "The Pantheism Controversy" focuses on Strauss's writings; and "Redemption through Sin" investigates Scholem's work. Jonas, a philosopher, is best known for his work in philosophy of biology, technology, and bioethics, providing the conceptual foundations for Germany's Green party and the environmental movement; Strauss, a political theorist, is best known for his work in natural rights and the idea of reading texts esoterically, providing conceptual foundations for American neoconservatism; and Scholem, a Jewish theologian, is best known for his work in Jewish mysticism and Kabbalah. It is quite the conceptual task to bring together these three seemingly disparate thinkers under a coherent conceptual roof. The way that the gnosticism-pantheism dialectic threads together these three thinkers is impressive. It is perhaps no surprise that Lazier received the 2008 Templeton Award for Theological Promise.

Lazier draws the three thinkers together with a complex discussion about an issue that is important also for twenty-first-century academics who seek to integrate science and biblical theology, namely,

why so many Europeans between the wars thought themselves to live in a world marked by the active interruption of God's call or command ... [and] what sorts of human projects – political, theological, cultural, technological – were enabled by God's absence ... (P. xi)

The overt worry of each of these thinkers is that God's absence will lead to an even more fateful repudiation of the earth. They each suggest that a turn away from God did not "generate a turn towards the world," but rather turned the earth into an "object in the exercise of human will" (p. 201), drowned out by the hubris of "the incessant, indecipherable babble of the all-too-human voice" (p. 202). Lazier argues persuasively that Jonas's evolving thought has continuity in his constant struggle against different forms of gnosticism and that Strauss's work can be viewed as an equally lifelong opposition to pantheism. Scholem's antipathy to both heresies is more complex, but nevertheless is presented as a plausible reading of his thought development.

What would be of most interest to PSCF readers is the surprising way that concern for nature and theological stances intersect. Jonas's arguments against gnosticism lead him directly to a concern about human responsibility for the earth as something with its own integrity and independent worth. A conception of God withdrawn too far from reality (gnosticism) gave humans too much freedom to assert themselves over against nature. Equally, but from an opposite angle, Strauss's worry to avoid pantheism leads him back to a Greek separation between nature (physis) and human convention (nomos). Conflating God with reality too easily makes God into a human projection. Arguing for their separation allows Strauss to emphasize the importance of the former over the latter, where (Lazier argues) purposive and normative nature plays the role of a God-double in relation to humanconstructed society. And for Scholem, moving away from pantheism and gnosticism meant that God was both absent, withdrawing from the world to leave room for human action, and present, in the purposive process of life itself. Each in their own way wanted to "save the world" (p. 137) in the face of heresies they believed would have done the opposite.

However, Lazier points out a complex dynamic. First, attempts to avoid one heresy (e.g., pantheism) often rely on the concepts and stances of the other (e.g., gnosticism). Second, the attempt to avoid a heresy requires first to revive it as a real option, which consequently gives it an unintended new life of its own. Third, and most interestingly, through the dialectic of separation and integration of God and the world, each of these thinkers creatively relies on heresies of their own. Lazier's historical study shows on the one hand that the integration of faith and learning—theology and science, God and nature—is not an easy task; on the other hand, the most creative attempts at integration might well need to involve interrupting our received concepts of God. For faith (theology) to have something to say to science

might well always involve a heretical move, "redemption through sin" (p. xi), Lazier's preferred title for his book.

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THE FUTURE OF ATHEISM: Alister McGrath and Daniel Dennett in Dialogue by Robert B. Stewart, ed. Minneapolis, MN: Fortress Press, 2008. 212 pages, index. Paperback; \$19.00. ISBN: 9780800663148.

Daniel Dennett and Alister McGrath take the lead in this book, respectfully debating memes, culture, science, religion, and morality. Seven essays then follow seeking to engage in genuine dialogue between atheists and Christian theists.

Dennett and McGrath argue about the status of memes and whether religion is, on the whole, a force for good or evil. Dennett argues that religion/God is a meme, a cultural replicator, and that it acts like a parasite in relation to its host: "It's ideas, not worms, that hijack our brainsreplicating ideas" (p. 24). He uses the example of a lancet fluke infecting the brain of an ant, which, thus infected, engages in suicidal behavior. The fluke gets the ant to climb to the top of a piece of grass in order to be eaten by a ruminant and, hence, to complete its life cycle in the ruminant's stomach. Dennett implies that what has happened to the ant happens also to adherents of the Islamic faith (p. 23). Believers must first surrender (the meaning of the word islam, Dennett points out) their mind and will to Allah. They are now prepared to engage in whatever rational or irrational acts and beliefs that their faith requires.

McGrath is interested to know from Dennett whether he thinks atheism is also a meme or whether he reserves this term strictly for ideas that he does not like, such as God and religion. McGrath says that if Dennett denies that atheism is a meme, then he is making a special, unjustified exemption for his own pet idea while explaining away rival ideas with which he disagrees (p. 32). Dennett admits that atheism is a meme too, though he does not appear to realize how this compromises his own position. Though memetic explanations of ideas should be value-neutral in Dennett's scheme, here, Dennett seems to employ memes as a way of discrediting the idea under consideration. Having admitted that atheism is a meme, Dennett has no choice but to agree that this meme may be the same sort of repugnant, parasitic and irrational force as the religion/God meme. In fact, McGrath gently chides Dennett that this is not what Dawkins (Dennett's inspiration) would have said:

... if Richard Dawkins was standing here ... I think his view would be that belief in God is a meme whereas the belief that there is not a god is so selfevidently true that it doesn't actually require memetic explanation. (P. 40)

Furthermore, McGrath poses pointed questions on the explanatory function of memes, their testability, and even their very existence (p. 31). Dennett does not muster much more of a reply. For a fuller critique of memes, see McGrath's *Dawkins' God: Genes, Memes and the Meaning of Life* or the work of Mary Midgley or Holmes Rolston III.

After the McGrath/Dennett debate, Keith Parsons argues that religion has been responsible for many of the social and political evils of our time and that atheism is having a kind of revival in tandem with religious belief. William Lane Craig offers a series of traditional approaches to the existence of God and adds the anthropic principle. Evan Fales repeats standard arguments against belief in God, based upon the incoherence of the Christian doctrine of Atonement and the problem of evil. J. P. Moreland discusses the work of Thomas Nagel. Moreland claims that Nagel maintains the objectivity and universality of reason, but illegitimately avoids the option of theism as reason's ground. Since Nagel (and Moreland) hold that evolutionary naturalism cannot work as reason's foundation, Moreland concludes that Nagel's claim that reason is its own foundation and authority, is incoherent. In similar fashion, but in the moral sphere, Paul Copan argues that evolutionary naturalism cannot adequately ground our sense of the objectivity of our moral intuitions. Ted Peters, in one of the best essays in the book, furnishes us with a careful rebuttal of the claims of Dawkins and Harris, that religion is a force for violence and evil while science is a force for peace and justice. In addition, Peters provides a nuanced analysis of Dawkins' rejection of the "God hypothesis" by offering helpful distinctions between natural revelation, special revelation, and the "theology of the cross."

The debate between Dennett and McGrath is the most insightful part of the book, even though Dennett does not make the best case for his position. Though all of the essays in this collection address the clash of atheism and theism, the book does not stay focused on the "new atheists" (as exemplified by Daniel Dennett's Darwinism) but addresses all brands of atheism—past, present, and future. This book is recommended to those who wish to explore the case for and against belief in God, and as an example that civil, respectful, and fruitful dialogue can be achieved by those with opposing worldviews.

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RELIGION & BIBLICAL STUDIES

RELIGION AND ITS OTHERS: Secular and Sacral Concepts and Practices in Interaction by Heike Bock, Jörg Feuchter, and Michi Knecht, eds. Frankfurt: Campus Verlag, 2008. 247 pages. Paperback; \$45.00. ISBN: 9783593386638.

"Avoid dichotomies. Dichotomies will almost always get you in trouble, because they artificially create opposites where they often do not actually exist." This is advice given to me years ago as a grad student and which I now pass on to my own students. It is particularly helpful to those in leadership studies, as organizational leaders are often asked to make decisions from a presentation of either/or options. I make it a matter of principle (and advise my students to do likewise) that there be at least a third option on the table before any decision is made. Truth be told, there are often far more options available than that, were one to invest the creative energies into identifying or formulating them. It is this insistence on

creativity that often characterizes excellence in decisionmaking.

Avoiding dichotomies is also sound academic wisdom, particularly when one is engaged in the kind of sociohistorical inquiry represented by this study. And, indeed, the framing provided by the editors of this collection of otherwise somewhat miscellaneous essays is motivated by a desire to overcome the prevailing dichotomous wisdom regarding religion and its interactions with its "other" in the modern world. The "other" is defined here rather broadly, first and primarily as "the secular" (although part of the intent of this volume is to challenge some notions of what constitutes "the secular"), and then secondarily as other expressions of religiosity, or even other religions. In other words, what happens when religious people, traditions, or beliefs intersect or interact with other people, traditions, or beliefs in a modern context?

The prevailing narrative of the modern era, particularly for Europe, which is the primary (albeit not sole) focus of this text, is the slow ascendance of secularism accompanied by a parallel decline in its dichotomous opposite, religion. As one surges, the other recedes. A subsidiary but complementary narrative of the modern era, one that has been particularly popular over the past decade or two, is that of competition between mutually exclusive, intolerant religious cultures or traditions ("the clash of civilizations" motif made famous by the late Samuel Huntington). The editors of this volume challenge both narratives, arguing instead that the interactions between religion and its other have been far more complex, dynamic, and creative than these simplistic meta-narratives relate.

This is not the first time either of these narratives has been thus challenged, although it is refreshing to see such an argument arise from central Europe, where the "secularization thesis" appears to have deep roots and where, truth be told, historical trends seem to bear out the arguments of the thesis. In North America, particularly in the United States, the secularization thesis has not held as much water, despite repeated attempts by sociologists and historians to impose it on our own narrative. Nor has the American experience of religious pluralism borne out the kind of religious strife and animosity that would be expected by the "clash of civilizations" motif. Instead, we find ourselves confronting a society that sees itself as simultaneously more secular and more spiritual, depending on how those terms are defined and practiced, and as simultaneously more tolerant of other faiths and more self-expressive of its own.

The essays that constitute the bulk of this volume are case studies and illustrations of this complexity. They are divided into three categories or sections: "Rethinking Religious Reform," which consists of four essays regarding Islam's confrontations with liberalism or secularism; "Rewriting Genealogies," which contains three historical essays presenting revisionist interpretations of particular episodes in Christian, Jewish, and Islamic history; and "Transcending Borders and Boundaries," which comprises four essays exploring how religious beliefs overlap or interact with other perspectives in a variety of geographical and historical contexts.

Three essays in particular may have special interest to readers of this journal. "Beyond Religion: On the Lack of Belief during the Central and Late Middle Ages" rejects both "atheism" and "unbelief" as coherent categories for this time period, as expressions of an anachronistic secularization thesis upon the medieval era. "The Devil in Spandau: Demonology between Religion and Magic at the End of the Sixteenth Century" examines an outbreak of devil-sightings in this Lutheran-controlled town and interprets them, not as a residue of an older folklore but as an integral expression of a formed Lutheran piety. And, finally, "Science Treats, but Only God Can Heal: Medical Pluralism between Religion and the Secular in Ghana" looks at how neo-Pentecostal faith healing and modern psychiatric methods have been blended in a particular setting in recognition of the multiple belief structures extant and even flourishing simultaneously in West Africa.

Unless any of those essays are of particular interest to you, however, I would not recommend the book for further reading. It is the product of an academic conference by the same name at Humboldt University, Berlin, in the spring of 2007, and conveys a "let's see what is submitted" feel. The essays are all over the place in terms of both content and context, and there is very little of an interpretive thread tying them together. The editors attempt to provide this in the introduction, but the result is an extremely dense and overblown essay that is painful to wade through. Alas, one must wade, for the essays have no coherence at all without that introduction.

The other piece missing in this text is a fresh metaphor. The volume rightly rejects the dichotomies and suggests that reality is considerably more complex than the standard narratives imply. But in rejecting "this," what is the "that" (or multiple "thats") to which they are pointing?

Neither the authors nor the editors of this book offer a new theory about religion and its other after the post-secular turn, nor do they think that this is the moment for such theory building. Rather they would already be satisfied if, with this volume, they could be conducive to a further deepening and elaboration of the insight ... "we know less about secularization than we think we do." (P. 20)

Perhaps. The humility is appreciated. But this reviewer found himself wishing that they knew more than they think they do. A miscellaneous collection of essays may help persuade us, if further persuasion is needed, that the old narratives have lost much of their explanatory power; what it does not do is give us fresh metaphors for the reality we inhabit. And, given the state of public, global discourse regarding religion (particularly in its relationship to science), a fresh metaphor or two would be most welcome.

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SCIENCE AND SOUL by Charles Birch. West Conshohocken, PA: Templeton Foundation Press, 2008. 196 pages. Paperback; \$24.95. ISBN: 9781599471266.

Charles Birch, former professor of biology at the University of Sydney, is one of the world's leading ecologists and winner of the Templeton Prize for Religion in 1990. His early investigations on insects led to an interest in ecology. He studied genetics and ecology at the University of Chicago and at Oxford University, and went on to help lay the foundations for the new science of population biology. His search for a philosophy that could embrace both science and religion culminated in what he calls "an ecological model of God."

As stated in the introduction, this book has a twofold origin. One was the suggestion from a colleague that Birch write about the people who influenced him during his long professional career as a biologist and university professor. He responded by writing about evolutionary biologists, animal ecologists, philosophers of religion, and those concerned with science and religion who had an impact upon his own thinking. The first four chapters of the book describe the personal characteristics and philosophical convictions of a number of influential individuals whom Birch has known personally. Those who receive the most coverage are evolutionary biologists Theodosius Dobzhansky, J. B. S. Haldane, and Sewell Wright; animal ecologists Charles Elton, H.G. Andrewartha, and Thomas Park; and philosophers of religion Harry Emerson Fosdick, Charles Hartshorne, Paul Tillich, and Reinhold Niebuhr. In describing the life philosophies of these scientists, Birch focuses on whether they were materialists and on how they reacted to his own philosophy of life, which is nonmaterialistic.

The other origin of the book was the suggestion from several colleagues that Birch should write a nontechnical account of his own life philosophy, that of process thought. The last two chapters of the book are devoted to this task as Birch summarizes his understanding of pansubjectivism in chapter five and panentheism in chapter six. Chapter five begins with a description of the modern mechanistic or materialistic worldview that has been the dominant model in science over the past three hundred years. Birch then explains his "constructive postmodern worldview" which rejects scientism and seeks unity between science, ethics, aesthetics, and religion. While scientism understands life to be matter-like (materialism), Birch believes that matter is life-like. This position is known as panpsychism, panexperientialism, and also by the term which he prefers, pansubjectivism.

Chapter six is devoted to an explanation of the theistic version of this worldview known as panentheism. This is the idea that the world, in some sense, is in God and that God is, in some sense, in the world. Panentheism differs from classical theism which separates God from the world, and from pantheism which identifies God with the world. Panentheism claims that God is everywhere and permeates the world, but is not identified with it. Process thought, according to A. N. Whitehead, envisions God as having two natures. God's primordial nature is the presence of God in the world which proffers the world possible values and acts by persuasion. According to Birch, the fact that God's power is persuasive and not coercive means that God is not unilaterally responsible for any event. This makes God and the world co-creators. God also has a consequent nature in that God responds to the world with compassion, and fully shares in the world's suffering. God is not the Unmoved Mover of Aristotle, but a God who changes in response to what happens in the world. After presenting an overview of process thought, Birch concludes the book with a description of the practical consequences derived from this worldview, particularly as they relate to ecological sustainability and the rights of animals.

While readers of this journal probably would not want to purchase this book (it is rather pricey for a fairly slim paperback), they are encouraged to read it for two reasons. First, the book provides a very readable, first-hand account of the social nature of both science and religious belief. In Birch's case, he had the privilege of interacting with a number of very influential scientists and theologians, which makes the book all the more interesting. Second, the book presents an overview of process thought that is concise and accessible to those who may not be familiar with its major claims. Missing from the book, however, is an attempt to interact with any kind of "middle ground" between Birch's self-described fundamentalist Christian upbringing and the liberal theology he embraced as a graduate student. While proponents of process thought will find Birch's pilgrimage to be informative and inspiring, those who hold more traditional theological views may want to by-pass this book and prefer to read about the pilgrimage of Francis Collins in his book The Language of God (Free Press, 2006).

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SCIENCE DISCOVERS GOD: Seven Convincing Lines of Evidence for His Existence by Ariel A. Roth. Hagerstown, MD: Autumn House Publishing, 2008. 251 pages. Hardcover; \$19.99. ISBN: 9780812704488.

There have been seemingly countless books written about the relationship between science and religion. What is distinct about this one is that Ariel A. Roth, former director of the Geoscience Research Institute and former editor of the journal *Origins*, has chosen to focus on scientific discoveries, and in some cases the absence of scientific discoveries, as pointing one toward believing in God.

Although I had encountered almost every idea in this book before, I did find it enjoyable and interesting reading. Each chapter begins with an anecdote, and further anecdotes and stories are given within the chapters to illustrate many of the points. One problem I encountered was that in certain stories, the information given seemed to be incomplete. For example, on pages 159–60, the author discusses the "continental drift" controversy and implies that scientists as a group just decided to believe in continental drift within the span of a few years and with no apparent reason. Absent is any discussion of the geological research that led to the development of the modern theory of plate tectonics.

The first five chapters of the book discuss different aspects of science and how they relate to God, touching on such subjects as the big bang, fine-tuning of particles and forces, chemical evolution, irreducible complexity, new genetic information, fossils, geologic time, and the Cambrian explosion. The points made in these chapters

will probably already be familiar to those acquainted with the origins debate. In fact, these points, and criticisms of them, are discussed in greater detail in other works. This book is not an exhaustive description of any of the things mentioned above, nor does it introduce various Christian viewpoints about the different branches of science and their conclusions. Nevertheless, it fulfills its purpose as a brief survey of some different fields associated with the intersection of science and religion, and provides one interpretation of them.

The final three chapters are more difficult to relate to the central themes of the book and seem disconnected at times. Chapter six discusses paradigms in science and how they can change, and lists ways to recognize "good science." Chapter seven briefly discusses sociobiology and determinism vs. free will, among other things. The final chapter summarizes the evidence presented in the book, discusses some of the good and bad aspects of science, and touches briefly on the problem of evil. The "seven convincing lines of evidence" referred to in the subtitle are not neatly delineated within the chapters of the book, but they are summarized in the concluding chapter. A handy table on page 229 lists them as matter (chap. 2), forces (chap. 2), life (chap. 3), organs (chap. 4), time (chap. 5), fossils (chap. 5), and mind (chap. 7). The book is also equipped with a glossary and a helpful but not exhaustive index.

In conclusion, I did not find this book to have much that is new to contribute to the science/religion conversation. It does, however, have merit as an introduction to various ways in which science may be seen as pointing toward God, especially within the framework of old-Earth creationist ideas.

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SCIENCE AND ASIAN SPIRITUAL TRADITIONS by Geoffrey Redmond. Westport, CT: Greenwood Press, 2007. 234 pages. Hardcover; \$65.00. ISBN: 9780313334627.

This is a useful and wide-ranging book that looks at the relationship between science and the Asian spiritual traditions. To date, that interaction has been relatively ignored. Since Asia is, in fact, composed of a large number of diverse countries, the author mainly limits the discussion to the Chinese and Indian traditions that are arguably the most influential. Besides the first two chapters that introduce the basic issues and the author's approach, topics explored by the author include the traditional Indian cosmology (chapter 5), and how various disciplines such as astronomy, astrology, ecology, medicine, and ceramic technology have interacted with spiritual traditions in the history of Asia, mainly in China but also in India (chapters 6–9).

I welcome this book that should greatly help those who want to have an introductory survey of this area. It is written in an accessible nontechnical style. The author has interesting things to say about many Asian practices in science and religion, and his explanations are, on the whole, clear and accurate. The book also contains a chronology of both China and India, the English translation of some important primary sources, and an annotated bibliography. In general, the author adopts a balanced approach to these issues. On the one hand, as a biomedical scientist who greatly values empirical studies, he is not prone to uncritical glorification of the Asian traditional wisdom. For example, he says that "we need not out of sentimental attraction to such theories as yin and yang regard them as adequate alternatives to science" (p. 4). On the other hand, he is not a proponent of scientism who dismisses the Asian spiritual traditions as merely superstition. He advocates a sympathetic understanding of both traditional scientific ideas and religious ideas in their historical contexts.

I also, on the whole, accept the major conclusion of the book. The author tries to appreciate the fact that the Asian civilizations have produced some real scientific achievements. For example, "China made many important inventions and discoveries," and "India developed observational astronomy to a high degree of accuracy." However, "the predominant mode of intellectual analysis in both civilizations was correlative rather than causal" (p. 17), and this has to some extent inhibited the development of modern empirical science. These correlative schemes are founded on the metaphysical idea that the macrocosm corresponds to the microcosm of the human body or human society. They had "spiritual significance because they described an orderly world that functioned by comprehensive principles such as yin-yang or the three gunas" (p. 19). Unfortunately, this perspective is not favorable to the development of science.

I think this book also has some limitations. One minor thing first: the author mentions the "antireligious rhetoric from scientists such as Richard Dawkins and Steven Weinstein" (p. 20), and the latter is referred to as a Nobel laureate physicist (p. 30). While there is indeed a scientist-philosopher named Steven Weinstein, I am not sure whether the author intends rather to talk about Steven Weinberg (especially in association with Dawkins).

The author's understanding of the philosophy of science still has a positivistic bent and consequently he sometimes tends to make simplistic judgments. While he does not want to say metaphysics is inferior, he does hold that "purely speculative thought must be distinguished from science" (p. 9). He takes science to be the systematic study of the external world that is cumulative and verifiable. In contrast, metaphysics is beyond experience and hence "can neither be empirically verified nor falsified" (p. 15). While I agree that as a matter of fact natural sciences are much more subject to empirical confirmation or disconfirmation, I do not think the distinction between science and metaphysics is that clear. In the historical development of modern science and also in contemporary cosmology, it is sometimes difficult to know where science ends and metaphysics begins. The most difficult problem is that nobody really knows how to define verification and to provide an algorithm for it. The now widely accepted idea of inference to the best explanation as a legitimate scientific methodology is, in fact, also appealed to in metaphysics and many other realms of human inquiry. However, I need to point out that the author does not dismiss metaphysics as mere nonsense and valueless rubbish. I also agree when he wants to say that "alchemy has minimal relationship to scientific chemistry" (p. 11),

and it is "more accurate to label alchemy as pseudoscience" (p. 19). Some Chinese ideas are also debunked: "Performance of calculations and use of a compass with mysterious markings no doubt made feng shui more impressive to clients but that did not make its performances at all scientific" (p. 20). Not everything is good science, but the distinction is sometimes messier than he allows.

The author has also misunderstood Kuhn's theory of paradigms. He correctly points out the fact that in both China and India there was no dominant paradigm in the past that guided scientific research. There was just the juxtaposition of diverse metaphysical and scientific ideas. So he concludes that "[s]cience in Asia did not fit the model of Thomas Kuhn" (p. 32). It seems to me he has ignored Kuhn's emphasis that the emergence of a paradigm was, in fact, no small achievement. Kuhn has already pointed out that in many areas of study the scholars are still in the pre-paradigm stage where there is only endless debate about the basic ideas.

Moreover, I think the author does not fully understand the complexities of the Chinese idea of Tian (Heaven). He thinks that Tian "refers both to the physical sky or cosmos and to an abstract ordering principle" and is "impersonal" (pp. 40, 57). This is a controversial issue in Chinese philosophy. The Marxist Chinese philosophers usually argue that Tian just means nature because that fits with their atheistic or naturalistic traditions. Moreover, many Western scholars in Chinese philosophy suggest that Tian is an impersonal rational principle which allows the Chinese to have a moral foundation without any belief in a personal God. I believe both interpretations may have roots in some elements of the Chinese traditions but are not true on the whole, especially if we consider the earliest origins of Chinese culture.

The most common Chinese translation of the word "God" is Shang-ti (or Shang-di), which means "the Emperor above." Both Shang-ti and Tien are widely used in the ancient Chinese classics, and point to the belief in a kind of personal God among the ancient Chinese. The name Shang-ti has already appeared in the oracle bones, and it stands for the Supreme Lord of the universe. In the Hymn of Shang, it was said, "So wise and prudent in his prime, He always cherished glorious fame; Toward the Shang-ti meek and tame." Shang-ti or Tian cannot just mean the physical nature or some impersonal force because he was regarded as a fearful God who had a moral will. For example, in the Book of History, there is the Pledge of Tang which said, "The leader of Xia is guilty, and I, who is afraid of Shang-ti, dare not but send a punitive expedition against him!"

The name Shang-ti was used widely in the Shang Era, but later in the Chou Era, the name Tien (Heaven) became more and more popular. Some scholars suggest that Heaven has entirely lost the meaning of a personal God, and just stands for nature or something like that. This is not quite true, though the situation is complicated. The Chinese people continued to use the name Shang-ti until recent times, and Heaven sometimes is just another name for Shang-ti. Confucius also believed in a personal Heaven. Indeed, Confucius seems to have a personal relationship with Heaven in that he prayed to Heaven and knew that Heaven can be offended: "He who is against Heaven has not none to whom he can pray." He felt that only Heaven could really understand him, and this understanding was the basis of his mission in life: "I do not murmur against Heaven. I do not grumble against men. My studies lie low, and my penetration rises high. But there is Heaven; —that knows me!" So it is wrong to say Confucianism is only a kind of ethical humanism.

Although the book focuses on the science-religion dialogue in the East, I would suggest that a comparison of this dialogue in both the East and the West would be illuminating, but the author fails to pursue it. The literature on the science-religion dialogue in the West is so vast now that I find it surprising that in his entire bibliography only one book on this dialogue (Barbour) is listed. For example, in chapter four the author has a helpful discussion of Needham's problem, i.e., why modern science did not emerge in the long sophisticated history of China. He has correctly pointed out problems such as the overemphasis on moral knowledge and the imprecise and fuzzy ideas of yin-yang and wu xing (five phases) in traditional China. He also lamented the Chinese lack of the spirit of empirical method, and he observed that the Chinese have never tried to test the empirical accuracy of these ideas nor cared about inconsistencies in the corollaries of these ideas.

As a Chinese, I can testify to the fact that I am not at all inclined to think that the natural world has to be very rational or consistent. If the world is regular enough to allow our survival, I think we should be grateful. Why should I expect the world to be conforming to a rational order down to the smallest details? That is why I was struck by Whitehead's discussion on this topic when I read it the first time. He pointed out that modern science had its root in medieval theology that emphasized the rational nature of the Creator of this world. From this conviction, the pioneers of modern science derived the idea that the world has to have a precise rational order which can even be expressed in mathematical formulae. The author has briefly referred to this idea (p. 75). In fact, this theme has been elaborated on many scholars, and some have also compared cultures along these lines (e.g., Stanley Jaki). If the author had further contrasted developments of modern science in different cultures in more detail, I think it would have helped us to understand Needham's problem more clearly. I also find the discussions not as deep as one would like to see, especially concerning the inner meaning of Asian spiritual traditions. Perhaps the scope of the book is just too broad for that. On the whole, the book is still recommended for those who are interested in the science-religion dialogue in a multicultural context.

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CHRISTOLOGY AND SCIENCE by F. LeRon Shults. Grand Rapids, MI: William B. Eerdmans Publishing Company, 2008. 171 pages, references, index. Paperback; \$30.00. ISBN: 9780802862488.

Until quite recently, F. LeRon Schults was a professor at Bethel University. He is now a systematic theologian at the University of Agder, Kristiansand, Norway. In this

work, he relates three Christological themes of incarnation, atonement, and parousia to current developments in evolutionary biology, cultural anthropology, and physical cosmology. Can knowing who Jesus was in the incarnation be conceived within biologists' current understanding of the evolutionary nature of human beings? Can how Jesus acted in the atonement be conceived within anthropologists' current understanding of the embeddedness of human behavior in specific cultures and unique relationships? Can the eternal presence of Jesus through the Holy Spirit be conceived within cosmologists' current understanding of the nature of reality and the origin/and future of the universe?

To begin with the first pairing, Evolutionary Biology refers "generally to those sciences that deal with the continuity and discontinuity of human life with other forms of life that have emerged on earth," while the doctrine of the Incarnation refers to the proclamation in John 1:14 that the Word of God became flesh in the person of Jesus of Nazareth. How can we know whether either of these is "true?" Shults considers this under three polarities that have been used to understand human beings in general and Jesus in particular: sameness and difference, body and soul, origin and goal. His major contention throughout the volume is that the philosophical assumptions within which knowledge has been sought-both theological and scientific - have changed throughout the centuries. Thus, the classical concerns with (1) how Jesus could be fully God and fully human at the same time; (2) whether humans' relationship with God is mediated through a spiritual soul that co-exists alongside their physical bodies, and (3) whether human destiny can be conceived as joining Jesus in an ethereal heaven – were all initially based on a Platonic epistemology that no longer prevails.

Current "methodical physicalism" in biology suggests that much of our understanding of Jesus is derived from ongoing discoveries of the natural capacities of human beings. Thus, in a re-construction of the Incarnation, it might be preferable to say that Jesus was a supreme example of human development and to proclaim that "God is like Jesus" instead of saying "Jesus is like God." To realize that Jesus represented the evolved human cognitive capacity to be spiritual, eliminates any need to postulate a separate substance to account for Jesus' special ability. As the Swiss theologian Karl Barth stated, "Jesus is who we are!" For Christians, "heaven" begins now through the way Christians participate in the life revealed in Jesus.

Cultural Anthropology refers broadly to those sciences that attend to the dynamics underlying individual and interpersonal human behavior, whereas the doctrine of the *Atonement* refers to the effect of Jesus' life, death, and resurrection on that same human behavior. Both the social sciences and the atonement deal with the how, why, when, and where of human action. How can a onetime event, Jesus' death on the cross, be understood to have an effect on "all" human behavior, when that crucifixion was embedded in the context of first-century Judaism? Shults considers this and other related issues under three pairs: (1) particular and universal, (2) law and order, and (3) us and them. In regard to the first pair, Shults' intent could be summarized in his statement that he wants to explain "how the agency of the *particular* person, Jesus Christ, empowers creaturely participation in the *universal* love of God." He notes that atonement theories have shifted away from any effect Jesus' life, death, and resurrection have on every person everywhere, to a focus on individual responses to Christ. Although some theorists are convinced that conversion is primarily a group effect, even within groups, conversion decisions are made by individuals. It is perfectly appropriate to ask of persons "Is Jesus 'your' Savior and Lord?" Because individuals live within unique cultures and communities, response will differ widely, and will be embedded in personal as well as relational contexts and expressed in various linguistic modalities.

Building on the contemporary understanding that religion always functions within cultures, Shults notes that atonement theories have often been concerned with law and order. Anselm's satisfaction theory, in which God's sense of anger over human sin is satisfied by Christ's death, is but one example. However, the concept of a God-given natural law that humans violate, has given way in modern jurisprudence to reason-based regulations designed to control human self-interest. A number of social theorists are attempting to re-engage theologically in rethinking the concept of a "just" society that goes beyond self-interest to a concern for human dignity, and takes into account race, gender, and poverty. Reconceived reflection on the implications of atonement will play a significant role in these dialogues. A restored emphasis on the universal implications of Jesus can, hereby, be reintroduced under the label of "globalization."

Physical Cosmology refers not only to physics but to all the sciences that deal with the nature of the universe (astronomy, quantum theory, emergent complexity, etc.). Parousia deals with the theological affirmations about the presence of God in human existence, here and now through the Holy Spirit and, in the future, through the return of Christ at the end of time. Shults suggests that physical cosmology and the parousia have a shared interest in "what does it mean to be a human being in the midst of these ideas?" Human beings are constrained by anxiety over their finitude, and long for security, freedom and fulfillment-both now and in the future. What is the metaphysic that will provide hope and assurance for human life? What is the nature of being and becoming in a cosmology that exceeds our imagination but where the resurrected Christ is both present as guide and promise? Is there a way to experience dignity in life lived on a small planet that revolves around a mediocre star within unlimited stars, around which other planets that are hospitable to life exist? As in his other chapters, Shults considers these issues under three pairs: space and time, cause and effect, and matter and spirit.

Given that the Christian faith arose in a period called "middle Platonism," it naturally shared the latter's assumptions that space was an empty container for matter and that time could be understood as the movement of bodies "in" space. Space did not change in the least as humans moved through it. Human movement was an imitation of the completely reasonable (read "spiritual") realm that existed above space and time. This "above and below" cosmology in both science and religion was shaken by the Copernican revolution. "Space" was no longer static and unchanging. Humans affected space which itself was dynamic and expanding. They no longer moved through an unchanging medium. Relativity theory and the idea of an expanding universe challenged linear approaches to Christian eschatology.

Closely related to these changes in philosophical understanding of space and time are the categories of cause and effect. The "cosmological argument" for the existence of God has always presumed that God was the "first cause." Further, it expected that God would continue to cause events and would finally cause creation to reach a climax of either a beatific or a violent nature. The will of God was assumed to have been fulfilled supremely in the resurrection of Jesus and in the promise of the presence of Christ's Spirit in the world – the evidence of God's continual activity. Contemporary cosmological theory also concludes that something is happening, but the nature or the direction of those changes can no longer be predicted at either the atomic or sub-atomic levels. At best, these fluctuations seem probabilistic or chaotic. Nevertheless, the anthropic principle that focuses on the slight differences in conditions that would have prevented intelligent life, seems to contradict any such nihilism. But even this still fails to "prove" purpose in creation or that a divinity exists. What may seem as destruction of Christian affirmations in the Parousia may actually be a gift, according to Shults. He suggests that the affirmation of the irreducible human search for meaning in the midst of such agnostic scientific assertions may be, in itself, a basis for asserting courageously the faith that, while God may not be all powerful, or even unknowable, God is, nevertheless, present in the human search for dignity, justice, and purpose.

In regard to matter and spirit, Shults contends that the classic dualisms of soul/body or spirit/matter have been devastating for understanding Christology's relationship to science, because they relegated faith to a separate cognitive dimension similar to aesthetic preferences that are purely personal and unreal. Historically, the several differences of opinion about the presence of Christ in the elements of the Eucharist at least provide the possibility that the ongoing reality of the resurrected Lord can be expressed in a manner that accords with contemporary cosmological thinking. Particles, those elements of which matter was supposedly composed, are now understood as probability waves of dynamic energetic forces. Any distinction between matter and spirit is inconceivable. Moreover, concepts such as emergence have helped to make sense of simple and complex phenomena such as consciousness. It is no longer necessary to postulate a separate metaphysical substance (the soul) to make sense of our experience. Shults advocates a kind of "mysticism," a form of Christian faith that the early fathers disdained because of its presumption that only the few can be truly knowing or informed. Nevertheless, a reconstructed mysticism might be appropriate as a way of claiming that faith lies in something ultimately true and plausible, yet by its nature mysterious; absolute yet unknowable.

Shults' book is a significant contribution to an understanding of how the identity, agency, and presence of Jesus Christ might be conceived in terms that accord with modern science. As a survey of the shifting philosophical assumptions upon which recently developing theological conceptualizations about the meaning of Christ's person are based, this volume is unequaled. For those unfamiliar with current presumptions in scientific fields other than their own, this volume will provide a helpful introduction. Shults' constructive model for understanding Christology is a convincing effort to relate Christianity and science, and it should be of genuine interest to many readers of *PSCF*.

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SLAUGHTER OF THE DISSIDENTS: The Shocking Truth about Killing the Careers of Darwin Doubters by Jerry Bergman. Southworth, WA: Leafcutter Press, 2008. xvi + 477 pages. Paperback; \$25.00. ISBN: 9780981873404.

Charles Darwin once wrote that false facts are highly injurious to the progress of science, for they often endure long (Descent of Man). ASA Fellow Jerry Bergman would agree heartily with his assessment. In fact, Bergman begins this title with a dedication to all the individuals who paid a high price for doubting Darwinism. With this dedication, one is appropriately oriented for what the next 477 pages offer. Bergman speaks from firsthand experience, as he claims that he was denied tenure due to his creationist beliefs. Additionally, Bergman presents over three hundred case studies of individuals which show evidence that some university officials and faculty are apparently afraid of questioning what the role of Darwinian evolution should be in society today. All of the respondents reported some form of discrimination openly and often, whereas 70% claimed open prejudice, and nearly 40% claimed to possess evidence of clear discrimination based on their ID or creationist beliefs.

Bergman does not purport to prove or disprove Darwinian evolution, or the "New Synthesis" (often referred to as Neo-Darwinism). Rather, his primary concern is to depict the negative actions and attitudes of the dogmatic Darwinists displayed toward Darwin doubters. He argues that any form of discrimination toward these Darwin doubters should be classified as a hate crime. However, this brings up one of the most poignant weaknesses of Bergman's entire argument: discrimination is a notoriously ambiguous and perspectival occurrence, one that may be "perceived," but not readily proven or demonstrated. In fact, he sets forth eight types of discriminatory actions experienced by Darwin doubters: (1) derogatory and inappropriate comments or innuendos, (2) denial of entrance into graduate programs, (3) denial of degrees, (4) denial of deserved promotion(s), (5) practical censorship of their work from collegiate libraries, (6) denial of tenure, (7) demotions, and (8) in some of the more severe cases, even threats of bodily harm.

On a positive note, not all of the people whose interviews find their way into this title are positively disposed toward Bergman's view or analysis, which allows for a degree of diversity in presentation. This title seeks to show why it is unfair that all taxpayers fund and subsidize the teaching of an evolutionary belief-system with

which they may disagree. Whether or not that was accomplished is quite debatable. However, one thing is not: Bergman has done his research and crafted an impressive rhetoric thereby. All in all, Bergman's detailed case studies regarding the state of intellectual freedom to question Darwinian evolution is a valuable resource for the Intelligent Design (ID) movement. It is doubtful that any converts will be won over by his presentation, however, because the pro-creationist/ID bias is evident and immense. Nevertheless, it is a profitable read.

Reviewed by Bradford McCall, Regent University, Virginia Beach, VA 23464.

BEHIND THE SCENES AT GALILEO'S TRIAL: Including the First English Translation of Melchior Inchofer's *Tractatus syllepticus* by Richard J. Blackwell. Notre Dame, IN: University of Notre Dame Press, 2008. xiii + 245 pages, 3 appendices, notes, bibliography, index. Paperback; \$28.00. ISBN: 9780268022105.

The Hungarian-born Jesuit theologian Melchior Inchofer is not well known today, but he was one of the crucial players in the trial of Galileo for suspicion of heresy in 1633. As an advisor to the Holy Office, probably acting on instructions from Pope Urban VIII, he undertook a detailed examination of the book that led to the trial, The Dialogue on the Two Chief World Systems (1632). His vigorous rejection of the earth's motion, on the basis of the Bible and how it was interpreted by patristic authors, became part of the Inquisition's case against Galileo. In order to appreciate the significance of this, we need to realize that the ultimate goal of any proceeding initiated by the Inquisition was not to determine guilt or innocence by examining the accused; rather, it was to persuade the accused to confess an erroneous opinion, to recant formally and sincerely, and (in many cases) to perform acts of penance as part of a sentence pronounced on the accused. Inchofer's analysis, therefore, was instrumental behind the scenes of the trial: it gave the Inquisition all the evidence it needed to determine that Galileo's book defended a heretical opinion; and, as part of its decision, the Inquisition ordered the book to be placed on the Index of Prohibited Books.

In close proximity with the trial, Inchofer published a treatise, *Tractatus syllepticus* (1633), a full translation of which comprises 40 percent of this book. Richard Blackwell, emeritus professor of philosophy at St. Louis University, is a distinguished scholar whose work has often focused on the theological and biblical issues raised by Galileo's discoveries and writings. His translation of Inchofer's treatise is a very important contribution by itself, but he also provides translations of four short texts that shed further light on the trial, including the opening chapter from *Prodromus pro sole mobile* (written in 1633 and published in 1651), by the Jesuit astronomer Christopher Scheiner, a personal enemy of Galileo who also advised the Holy Office during the trial.

The remainder of the book reviews the legal and scriptural cases against Galileo, describes the activities and ideas of Inchofer and Scheiner, and closes with Blackwell's own thoughts about science and religion. Blackwell sees Scheiner, "the premier Jesuit scientist of his era" (p. 65), as something of a tragic figure. His life as an ordained astronomer confronted him "with the dilemma of reconciling his pursuit of scientific truth with the demands imposed on him by his religious faith and his Jesuit vow of obedience," such that he represents "the classic case of the clash between science and religion at the personal level" (p. 90). Blackwell believes that a similar tension has characterized the subsequent history of science and religion, stressing the presence of conflict more than most experts on that subsequent historywhich for the most part lies outside the range of his own scholarship. He is surely correct, however, to note that "the seventeenth century failed to bring about a cultural integration of science and religion, a condition that continues to our own day" (p. 101). I also agree that "the problem of the interaction between the authority of scientific reason and the authority of religious revelation has lived on, as science and religion have remained major cultural forces," but I do not entirely share his view that "the credibility of religious authority is what the trial [of Galileo] was, and still is, about" (p. 102). This is true as far as it goes, but it leaves too much unsaid about the personalities and institutions, including Galileo's own feisty arrogance, that also contributed prominently to the final outcome.

My misgivings do not at all diminish my enthusiasm for the meticulous scholarship that Blackwell provides. Owing to its narrow focus on two Jesuits who crucially shaped the Inquisition's case against Galileo, however, most readers will probably pass on the opportunity to benefit from this book – unless one really wants to know more about what happened behind the scenes, in which case this is an absolutely indispensable study of the most famous trial in the history of science.

Reviewed by Edward B. Davis, Messiah College, Grantham, PA 17027.



SPACES OF MOBILITY: The Planning, Ethics, Engineering, and Religion of Human Motion by Sigurd Bergmann, Thomas Hoff, and Tore Sager, eds. Oakville, CT: David Brown Book Company, 2008. 274 pages. Hardcover; \$95.00. ISBN: 9781845533397.

As the subtitle reveals, the scope of Spaces of Mobility is quite broad. Mobility is considered to mean much more than simply transportation; it consists of all the "spaces and places" created by "technically-constructed processes for movement of people, goods, and information." Moreover, the spaces and places include spiritual, social, and psychological dimensions. My interest in the book derived from my work on public policy affecting transportation, land use, and community development – topics often collectively called new urbanism. I have approached these subjects as an engineer, albeit with interest in the broad definition of space and place adopted by the authors. Thus I undertook this review hoping to find new insights into the very difficult social objectives of reducing private automobile use, promoting public transportation, and persuading the City Department of Community Development to pursue community

as much as they do *development*. In particular, in light of the known environmental, social, and psychological impacts of automobile-based mobility, why is it so very difficult to persuade people (including Christians) to embrace less damaging means?

The book includes ten chapters (essays may be more descriptive) plus preface and index, by eleven different authors on a variety of subjects in three categories. The authors are – broadly speaking – theologians, psychologists, urban planners, ethicists, and civil engineers. The essays are outcomes from an interdisciplinary research program at the Norwegian University of Science and Technology (Trondheim) from 2003 to 2006. Thus the book is more akin to a symposium proceedings than to a systematic treatise on a single theme. However, the preface – by theologian and senior editor Sigurd Bergmann, psychologist Thomas Hoff, and professor of civil and transport engineering Tore Sager – provides an overview and roadmap.

Part I includes three papers that reflect on the sociopolitical, environmental, and ethical aspects of mobility. At the outset of the first paper, "The Beauty of Speed or the Cross of Mobility?" Sigurd Bergmann reminds us that technological progress was elevated "to the pedestal of divine favor" during the late nineteenth and early twentieth centuries, and the private automobile came to be a central symbol. Reflecting on the negative impacts of "automobility," Bergmann questions whether any science can be correct if its applications destroy its object (nature); and whether a technology for motion can be true and good if its applications destroy the lives of citizens, society, nature, and climate. "In order to contribute to the discourse on technology and ethics," he writes, "the authors of this book have chosen to focus on the question of what image of humans we should use in technology development." This is a good one-sentence statement of the book's theme, and it offers a good segue to the spiritual dimension of the topic. Bergmann suggests that "modernism's myopic view of the relation between humans, artifacts, and nature" provides a poor basis for technology development; and that ecological psychology (a field of study that I surmise will be new to most scientists and technologists) offers a better alternative. But he asks "how could one ethically describe what is better?" I think the problem is correctly diagnosed; but – as Bergman acknowledges-the prescription is still lacking.

Tore Sager discusses hypermobile society, where individuals can travel anywhere, any time they choose, by whatever means they wish. But individual travel behavior cannot be forecast in such circumstances, with the result that planners cannot design rules and institutions to modify this behavior in prescribed ways. Moreover, hypermobility reduces the motivation of citizens to spend time in their communities or participate in democratic processes. Here is one example where utilitymaximizing market behavior and democratic decisionmaking ultimately collide with the Enlightenment idea of a human being becoming creator and master of his or her own world by acting on knowledge of consequences.

Urban planner Erling Holden tests the relationship between attitudes about the environment and household consumption. One observation is that "strongly committed individuals" tend to cast aside their green ethic when traveling for leisure. Nevertheless, energy consumption for housing and everyday transport can be reduced by control of land use. Holden also observes that habitual behavior is relatively independent of attitudes and beliefs—attitudes can change without corresponding change in behavior. He suggests that appeals to sustainability are ineffective for getting people to change their behaviors, and *flourishing* may be a more persuasive concept. In the final paper in Part I, environmental ethicist Anders Melin considers how "Christian ecotheology" might help shape a mobility ethic. He comes up with the concept of *pilgrimage* as a metaphor for ecologically and ethically sustainable mobility.

The papers in Part II consider the contexts among surroundings, artifacts, and the individual. Psychologists Kjell Ivar Øvergråd, Cato Alexander Bjrøkli, and Thomas Hoff address the moral (non)neutrality of technically aided human movement. Technological transportation aids may increase our capabilities for movement, they note, but do so without concomitantly increasing our ability to perceive and control this movement. The result is that technology engenders ways that we look on ourselves and on our civilization. Ethicist David Kornlid introduces the term *motility* to describe an individual's opportunities for movement in combination with his or her ability to appropriate them. Kornlid observes that our motor vehicles are an important part of our sense of self. The emotional investments we make in them transcend any economic calculations of costs and benefits, and outweigh any reasoned arguments about the public good or the future of the planet. This is why, despite the undisputed facts concerning the impacts on humans and nonhuman organisms, and whether we have developed "environmentally friendly machines," it is so very difficult to make an environmentally friendly culture of automobility. From my perspective the authors are correct about this point, but they do not seem to recognize the extent of human ability to rationalize our behaviors or deny their impacts. Garrett Hardin's classic "Tragedy of the Commons" showed us why utility-maximizing individuals are *compelled* to make choices that damage the commons.

Noting that mobility is one of the primary mechanisms of globalization, Professor of Comparative Religion Peter Nynäs examines the social and psychological impacts of frequent international travel. "Movements and ways of moving are important dimensions of human spirituality," he writes; they can influence one's worldview. Attachment to people and place, which forms a vital part of human existence, is difficult to achieve or sustain under these circumstances. Thus, increasing mobility is not only a threat because of its ecological impacts, but it is also a threat to the modern moral subject. (Now I understand why—following a year in which I took more than fifty business trips—I learned to hate business trips in general, and airplane travel in particular.)

Part III focuses on "the sociological differentiation of the landscape of mobility." Urban planner Tanu Uteng explores the subject by studying the lives of non-Western immigrant groups in Norway. She writes,

Although engineers, industrialists and the leading actors on the market today still advertise mobility as a concept composed of just two aspects – speed and

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overcoming distance – the understanding of mobility has crossed the narrow confines of speed and distance and entered the wider realm of identity formation, freedom, and rights.

Uteng finds that this immigrant group lacks power in Norwegian society and is therefore less productive because they do not have ready access to transportation. Next, civil engineer Liv Øvstedal writes about "inclusive mobility" from the standpoint of accessibility and participation. Øvstedal argues that transportation planning needs to be broadened into *mobility* planning, by incorporation of environmental and social dimensions and considering the needs of bicyclists and pedestrians. He calls for *accessibility*—meaning ease of use by children and the elderly as well as the disabled. "There is a challenge," he concludes, "in broadening the perspective of planners and designers to take into account people different from themselves." (Amen to that.) A table of "universal design principles" for these objectives is provided as an appendix.

The final paper – Tore Sager's second in the volume – (re)defines mobility as the *potential* transport of humans, and explores the relationship between mobility and freedom. In addition to the hypermobility discussed earlier, freedom must include the feasibility of the choice not to travel. "Enormous sums of money are spent on the improvement of mobility," he writes. And "the budgets are backed by a political rhetoric giving prominence to efficiency gains and the value of free movement." But "attempts to achieve freedom by more mobility should take into account some consequences of excessive travel that tend to have the opposite effect of what is intended." The paper includes the paradoxical loss of freedom that must result when the necessary surveillance measures for managing mobility are put into place. Freedom as mobility, Sager concludes, contains the seeds to very different developments of society.

Although some of the participants were theologians and religious ethicists, and the spiritual dimension of human existence received frequent mention, this is by no means a "Christian" work. However, many if not most of the conclusions are consistent with the biblical concepts of imago Dei and creation care. My original hope of learning new practical steps that can be taken to persuade Westerners to support and use public transit – or at least to reduce their use of private automobiles – was not completely satisfied. But I came to see that the research program that resulted in this book was undertaken to attain new understanding of the multidimensional nature of mobility in Western society. It was not intended to result in a handbook. Nevertheless, a number of fresh insights (at least to me) are reported. I discovered some new tools to use in my discussions with city and county planners. The book will appeal to scientists and engineers who are involved in technology and society in general, and transportation and land use in particular; it will appeal especially to those who have a philosophical bent.

One final comment: the book was printed in a very small type, at least for these aged eyes. No doubt this resulted in cost savings but at the sacrifice of readability. Yet the paperback version still lists at \$39.95.

Reviewed by J. C. Swearengen, 3324 Parker Hill Road, Santa Rosa, CA 95404-1733.

Letters

Can We Trust Our Minds to Tell Us about the "Multiverse"

I found Robert Mann's article on "The Puzzle of Existence" (*PSCF* 61, no. 3 [2009]: 139–50) very helpful in describing the challenges posed by the rise of the multiverse paradigm and the problems that arise when it is used to explain the particularity of our universe. In addition to the problems that Robert raised, I believe that the use of infinitely many universes to explain the seemingly low probability of our universe relies on an overconfidence in our scientific prowess.

To illustrate, let me suggest that, in addition to the universes envisioned under the physics of "string theory," there is another class of universes produced by different physics, that of "phlegm theory." In phlegm theory, all of the apparent "fine tuning" coincidences that we observe are naturally explained as the likely outcome of phlegm physics. Moreover, in a phlegm universe, intelligent creatures such as ourselves are almost certain to evolve. Sadly, however, the matter produced in a phlegm universe has limitations in its capacity to support advanced thinking. In fact, phlegm-based brains are not sophisticated enough to grasp the subtle, yet powerful, mathematics of phlegm theory. The best that the benighted phlegm brains can muster is an understanding of string theory. Thus, in a phlegm universe, it is virtually inevitable that the most advanced beings that evolve will be left pondering as to why their universe seems to have such peculiar properties, when, in truth, their universe is completely comprehensible under phlegm physics, only they are too obtuse to grasp this.

Now, my story of a "phlegm universe" is obviously fanciful. Suppose I therefore assign some very low probability, say 10-40, to the chances that something like this scenario might be true. Now contrast this to the probability that I am living in a very rare string theory universe, whose probability is even lower, say 10-100 or less. Should I not overwhelmingly prefer the explanation based on a "phlegm" universe or something of the like, since its odds of being the correct explanation, though tiny, are nevertheless much greater than the odds of being in an extraordinarily rare string universe? Put another way, unless I think that the odds that I have overlooked some better explanation for "fine tuning" are ridiculously small (less than, say, 10^{-100}), I am bound to take seriously other explanations (including ones I have not come up with yet!), even if they, too, are very unlikely. In addition to the "phlegm" universe, other explanations that ought to at least be considered include the following:

- When properly understood, string theory will predict that a universe like ours is probable.
- There is a very advanced being in another universe who created our universe with the properties that it has.
- We are really just computer algorithms running on an advanced computer programmed to make us think we are in a peculiar universe.
- Universes that are complex enough to produce intelligent beings are too complex to be understood by those beings.
- There is an omnipotent God, who made the universe the way it is to support our existence.

Only by assigning virtually zero probabilities (less than 10^{-100}) to all of these does one come to a conclusion that a multiverse explanation is the best one. This alone suggests that multiverse explanations be treated with considerable skepticism.

Ronald Larson ASA Member GG Brown Professor of Chemical Engineering Professor of Macromolecular Science and Engineering, Biomedical Engineering, and Mechanical Engineering Department of Chemical Engineering 2300 Hayward University of Michigan Ann Arbor, MI 48109-2136

Mann Responds to Larson

Ron Larson's fanciful example highlights the need to have a high degree of skepticism about extrapolating scientific knowledge well beyond its known limits. While I share his skepticism concerning the multiverse as an explanation for existence, it is important to listen to the arguments of its proponents, if only because of their prominence and number in the scientific community. Perhaps some old-fashioned intellectual wrestling with this concept, from both scientific and theological perspectives, might lead us to a deeper understanding of the particularity of our existence!

Robert B. Mann ASA Fellow Professor of Physics & Applied Mathematics University of Waterloo Waterloo ON N2L 3G1

A Heavenly Science?

In the two reviews of Hugh Ross's More than a Theory (PSCF 61, no. 3 [2009]: 201-3), neither reviewer mentions a problem with the old earth creationism argued by Reasons to Believe (RtB). If we consider just the fossils of genus Homo and its antecedents over about 5 1/2 million years noted by Robert B. Mann ("The Puzzle of Existence," ibid., p. 155), there were, among others, changes toward more efficient bipedality, increased manual dexterity, and a much larger brain. The obvious conclusion, if there are several sequentially created species involved, is that the Creator was experimenting, learning from the forms that went extinct. God's works then seem to parallel human experience, much like the shift from the vibrating ignition coil powered by dry cells of some early cars, through the breaker point, at first manually controlled and later by means of centrifugal and vacuum advance, to today's electronic controls. Human beings

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16. Publication	of Si Nublic	latement of Owntenhip adon is a general publication, publication of this statement is n secender: 2009 issue of this publication.	equired. Will be printed	Publication not required.			
17. Signature a	ind T	te of Editor, Publisher, Business Manager, or Owner		Date			
pa	~	Ul D. Lour Kandall D. Inaar, IX	ecutive Director	September 28, 20			

learned from the shortcomings at each level and adapted technological breakthroughs as they became available. Is God so limited in intellect that he must learn similarly? If Ross's deity were not learning from the sequence of forms, why did creation from Big Bang to now take nearly thirteen billion years?

An omnipotent and omniscient deity could have instantaneously created everything, fully formed and inhabited, as in the philosopher's game that posits a world only five minutes old. Why tinker over billions of years? Ross's problem does not arise if evolution, both physical and biological, is the means God determined for the development of his creation. Even Augustine recognized the possibility of instant creation followed by temporal development. There is a radical difference between a universe and its deity that (1) develops contingently within the rules determined by God or (2) is revised by regularly creating improvements based on what was learned through the interaction and extinction of the previously created entities. If God were not learning, the indication is that he was producing a multibillionyear pattern to mislead students of the universe. Ross's approach, contrary to his claim, is not a scientifically testable hypothesis, for it includes metaphysical or theological notions. It does, however, run counter to orthodox theology. I am certain that Ross and the staff of RtB espouse orthodoxy, but, unfortunately, the implications of their ideas do not match their intent.

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Note from the Editor

I am pleased to present a breakdown of the articles submitted to *PSCF* during the period from August 1, 2008 through July 31, 2009.

Articles and Communications	Total Submitted	Accepted	Pending	Rejected	Submitted by ASA/CSCA	Accepted from ASA/CSCA
Apologetics	2	1	1		2	1
Biotechnology	2	1		1	1	1
Cosmology	1	1			1	1
Design/ID	1			1	1	0
Environment	1	1				
Ethics	2			2		
Evolution	3	1		2	1	1
Linguistics	1			1	1	0
Mathematics	1	1			1	1
Medicine	1		1		1	0
Sci/Rel/HOS	4	2		2	2	1
Social Sciences	2	1		1	1	0
Theology	5	1		4	2	0
Scripture/Science	9		1	8	4	0
YEC/Flood	3	1		2	1	1
Author Exchange	1	1				
Essay Review	4	4			3	3
Interview	1	1			1	1
Totals	48	17 (35.4%)	4 (8.3%)	27 (56.3%)	24 (50.0%)	11 (22.9%)

Statistics: August 1, 2008–July 31, 2009

Arie Leegwater, Editor leeg@calvin.edu

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