

Reviews

Science, Life and Christian Belief: A Survey of Contemporary Issues. By Malcolm Jeeves and R. J. Berry. Grand Rapids, Mich.: Baker Books, 1998. 305 pages. \$19.99 (paper).

Everyone who participates in the science-and-religion conversation has some conceptual scheme for understanding science, religion, and their interaction. Most such schemes are relatively straightforward, and often it is possible to predict someone's stance toward science by knowing their stance on, say, the Bible. We are all familiar, for example, with creationists who reject much of mainstream science because it disagrees with the Bible; we know other theologians who reject anything in the Bible that disagrees with science. Both of these "camps" are large and well-defined in some predictable ways and the issues that divide them quite clear. But some of the more interesting players are those who join the respective concerns of science and religion in novel and unexpected ways. I am thinking of such anomalies as atheist chemist Hubert Yockey, who is allied with conservative evangelicals like Phillip Johnson in rejecting certain aspects of evolutionary theory; or theologians in the Barthian tradition who can't find anything relevant to religion in contemporary science; or Richard Dawkins, whose atheism gathers strong support from science; or Hugh Ross, for whom each new scientific discovery provides yet another apologetic argument for Christian faith; or Stephen Jay Gould, strangely allied with the Barthians in his belief that science and religion are unrelated and best understood as "non-overlapping magisteria." The roster on the masthead of this journal, in fact, contains an interesting assortment of thinkers, some of whom share very little beyond the belief that the conversation between science and religion is important or at least very interesting.

Authors Malcolm Jeeves and R. J. Berry have just such an idiosyncratic synthesis of science and religion, combining a full acceptance of both contemporary science and a conservative evangelicalism, understood from a Reformed perspective. Jeeves and Berry have long been important contributors to the science-and-religion conversation and are now both semiretired after decades of productive work in science. Jeeves has had an illustrious career in neuropsychology at the University of St. Andrews in Scotland, where he is now "honorary research professor." He also is the president of the Royal Society of Edinburgh. Berry has retired from a distinguished professorship in genetics at University College, London, and remains active in genetics research. Both publish regularly in science and religion and are on the editorial board of the British Journal *Science and Christian Belief*. They write from the perspective of "working scientists" (p. 11) and are fully aware of just how their religious beliefs interact (and, perhaps more important, do not interact) with their scientific work. *Science and Christian Belief*

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is an extensively revised and updated version of Jeeves's *The Scientific Enterprise and Christian Faith* (London: Tyndale, 1969), which grew out of a conference in which a broad range of participants came together to discuss issues arising at the interface of science and religion.

Jeeves's earlier book was broadly based and was widely used as one of the first texts in the embryonic period of what has been steadily evolving into the "discipline" of science-and-religion. The authors, together with such people as Ian Barbour, Donald MacKay, and Colin Russell, are thus in that small group of "pre-Socratics" who laid the foundations for this new field. The need for this more recent book is the continued shortage of science-and-religion texts that do not "restrict themselves" (p. 11) in some way—such as those by John Polkinghorne that do not deal in much detail with issues arising from the life sciences—or are written by "historians or philosophers of science" (p. 12) rather than scientists. These concerns, I think, are legitimate. To cover the bases in my science-and-religion course, for example, I rely on a number of texts—John Hedley Brooke's now-standard *Science and Religion*, Jerome Langford's classic *Galileo, Science, and the Church*, and a couple of anthologies. Even so, my students regularly visit the library to consult reserves.

The organization of the book approximates the form of an "Introduction to Science and Religion" course, starting with some general remarks about the origins of science, followed by a discussion of the nature of science, moving on to specific areas like cosmology, evolution, and psychology, and finishing with a look at contemporary problems needing attention. Such an ambitious survey runs the risk of a certain unevenness—mitigated in this case by the dual authorship—which is the reason why the majority of texts in this field are anthologies, which rely on a cross section of scholars, each contributing a particular expertise.

Consistent with this approach, the authors begin with a brief survey of "Hebrew-Christian and Greek influences on the rise of modern science." The confluence of these two cultural streams is understood to have catalyzed the scientific revolution in the way that has been described by scholars like Reijer Hooykas and Russell. The authors, clearly located within what H. Flores Cohen has called "The Great Tradition" (*The Scientific Revolution: A Historiographical Inquiry* [Chicago: Univ. of Chicago Press, 1994]), describe the science of the Middle Ages as "ossified" and (over)emphasize the revolutionary character of the developments from Copernicus through Newton. Using Jeeves and Berry's own terminology, Cohen critiques the Great Tradition as due, in part, to "*working scientists'* virtually inborn prejudices regarding the achievements of their predecessors" (p. 39; emphasis added). While such oversimplifications are perhaps unavoidable in a book like this, the authors should at least have acknowledged that recent work in this area, such as David Lindberg's *The Beginnings of Western Science* (Chicago: Univ. of Chicago Press., 1993), has certainly nuanced, if not called into question, the Great Tradition. Lindberg's important volume is not even included in the authors' lengthy bibliography of several hundred works.

The authors then turn to the question of the nature of scientific laws and their relationship to God. Both the "craftsman" (p. 36) and "creative artist" (p. 37) models for God are rejected as too far removed from the God of the Bible, whom they understand to be "sovereign" (p. 34), "outside the creaturely time scale" (p. 39), and who "may do miracles from time to time" (p. 47). The authors under-

stand miracles in the traditional sense as events “outside the laws of nature,” but they take natural law to be “weaker than a law of logic” (p. 46) so that God can act in the world without contradiction. Polkinghorne is cited in support of their position (pp. 45–46) but I do not think he would be entirely comfortable with their uncritical acceptance of the biblical miracle stories. However, Polkinghorne’s intuitions about the character of natural law come from physics, whereas the authors’ come from biology, and there is no good reason to privilege one of those perspectives over the other. The laws of physics, in fact, tend to resemble “laws of logic” much more than their biological counterparts do.

In the discussion of the scientific method, the authors’ perspective of “working scientists” begins to enliven their presentation. They critique “over-formalized” (p. 51) presentations of the nature of science and point out, in a way that I found very helpful, that such caricatured misunderstandings of actual science result from philosophers’ tendency to use “scientific papers and books rather than the working notes” of practicing scientists (p. 51) as their primary sources. Specifically rejected are the accounts of the positivists, the models of Karl Popper and Thomas Kuhn, and contemporary constructionists like Andrew Pickering. Imre Lakatos (strangely absent from the index) is quoted with approval: “The history of science is always richer than its rational reconstruction” (p. 54). The authors, in concert with virtually all of their colleagues in science, are realists, methodological naturalists, and see science as having a “self-imposed silence” (p. 67) on religious questions. They also believe that the “Christian worldview positively encourages involvement in the scientific enterprise” (p. 69) while warning that certain “world pictures” (pp. 62–65) emerging from science are antithetical to the Christian faith.

Most apparent conflicts between science and religion are readily resolved by recognizing that explanations, whether scientific or theological, can be on entirely different logical levels, a topic that occupies most of chapter 4. An analysis of a mouse learning a maze is provided to illustrate this point. The steadily growing competency of the mouse can be studied from the perspective of learning theory, of electrical activity in the mouse’s brain, or biochemical changes in the mouse. Scientists pursuing investigations along these lines would certainly not perceive their differing explanations to be in competition; they would understand that their explanations were at different logical levels and thus were best understood as complementary.

The authors next move into a discussion of some specific areas of science—cosmology, biological evolution, psychology. In each case mainstream scientific ideas are accepted, and familiar connections to religion are made—the anthropic principle à la Paul Davies, models for God’s action in the world à la Polkinghorne, mind-body analogies à la MacKay, and so on. While avoiding aggressive criticism of scientific creationism, the authors make it clear that that particular understanding of origins is neither biblically nor scientifically plausible. Many individual Bible verses are invoked to support their view.

The most detailed section of the book relates to human nature, one aspect of the science-religion conversation to which the authors, particularly Jeeves, have made important contributions. (See Jeeves’s *Mind Fields: Reflections on the Science of the Mind and Brain* [Grand Rapids: Baker, 1994]). Consistent with recent scholarship in a number of areas, they argue that a proper understanding of both

science and the Bible leads to a rejection of any sort of dualism that attempts to “divorce the mind from the physical” (p. 100). Here, as elsewhere, they rely heavily on the Bible for their religious understanding, with only occasional reference to the long theological conversation on this topic. Convinced that there is a single consistent biblical view, they exegete some problematical texts and critique some wayward interpretations, such as the belief that the scriptures speak of an “intermediate state” (pp. 149–52) between our present and resurrected existences. The tone throughout is congenial, however, and the authors acknowledge that, in the final analysis, what they are dealing with is “ultimately a mystery” (p. 152).

I found the authors’ scientific discussion of the mind-brain link—an area of science missing from my training in atomic physics—very informative, although I must confess to a certain unease when the discussion made use of concepts like “neurofibrillary tangles,” “granulovascular deterioration,” and “nigrostriatal pathways” (p. 175) without clarifying those frightening polysyllabic terms. The authors suggest that the mind/brain, while not itself a dual entity, nevertheless is best studied using a dualistic approach—top-down in the manner of psychology and bottom-up in the manner of biology. Here again we find the authors arguing for a multi-level approach that does not privilege a reductionist approach to such problems.

The last scientific topic in the book is an excellent discussion of environmental issues that the authors believe have been ignored because of the distracting debate over creation and evolution. Consistent with the generally conservative approach of the book, they are critical of “green” religion (p. 225), “green” science (p. 229), the Gaia hypothesis, and any theological models that make the universe a part of God, such as pantheism or panentheism.

Science, Life and Christian Belief concludes with a criticism of the high priests of scientific materialism—Peter Atkins, Francis Crick, and Richard Dawkins—followed by some suggestions for how science and Christianity should get along. The authors suggest that this relationship should be based on three insights: (1) “We live in a world which is in principle understandable” (p. 248); (2) “God has revealed himself to us” in the Bible (p. 248); (3) “We live in God’s world, and we are his stewards” (p. 249). “Our need,” concludes the book, “is not more science, better reason or great faith; it is faith in a great God” (p. 254).

Science and Christian Belief is unapologetically apologetic for an orthodox, conservative Christianity understood from a Reformed perspective. Traditional perspectives are defended throughout: miracles, the virgin birth, the Fall. The authors consistently reject any models for God, such as panentheism, that compromise either God’s sovereignty or the creator/creation distinction.

The authors also are clear on the primacy of scripture, which they “fully accept” as the “revelation of God” (p. 12). The approach to Genesis is somewhat concordist, affirming a historical fall while acknowledging that the historical sciences have established that “Adam and Eve could not be the physical ancestors to the whole human race” (p. 111). They employ the rhetorical style characteristic of conservative evangelicals, always referring to what the “Bible” says, rather than quoting individual authors of scripture, as is characteristic of more liberal scholars who understand the Bible as a collection of writings with a complex and varied authorship and not a unified revelation of God.

Science and Christian Belief is also unapologetically apologetic for an orthodox, traditional view of science, from the perspective of productive researchers with

decades of experience working in the life sciences. All of the established ideas of contemporary science are fully embraced, including evolution and the Big Bang. Darwin's work is described as a "brilliant attempt to synthesize a mass of previously unordered evidence" (58), and young-Earth creationism is dismissed as a "minority view" that results from a misguided "biblical interpretation" (p. 90). Even the intelligent-design movement is anonymously critiqued in a surefooted discussion of the character of scientific explanations which "become satisfying to a scientist only when they can be shown to be derivable from theories" and "not simply to be able to explain isolated phenomena" (p. 72). The book is replete with seminal insights such as this recognition of the nature of a "satisfying" explanation—insights that come, no doubt, from the authors' personal experience in the actual development of scientific explanations, as distinguished from "arm-chair" discussions of scientific explanation that look to philosophy or theology for guidance.

Jeeves and Berry's simultaneous affirmation of a conservative evangelical theology and mainstream science is both refreshing and unusual and probably communicates something interesting about the difference between British and American evangelicals. The overwhelming majority of American evangelicals, who would share the authors' "high" view of scripture, are most certainly going to be put off by the wholesale acceptance of evolution and the Big Bang. Such readers also will be surprised to find the authors insistent that a doctrinaire "pro-life" position on abortion is neither scientifically nor biblically plausible and creates a number of "problems at the ethical interface" (p. 168), a position sure to alienate conservatives. On the other hand, readers from mainline religious traditions, who resonate with the "high" view of science, will be surprised at the authors' summary rejection of panentheism, versions of which animate the theology of many of the contributors to this journal. "As Christian theology it [panentheism] is seriously defective because it relegates Christ's death to that of a mere catalyst within history, and empties it of all eternal significance" (p. 220). Chastened panentheists can, however, draw some comfort from the fact that the authors' harshest criticism is reserved for those who would argue that Christianity has an ethic of environmental exploitation.

But all readers should pay close attention to the authors' suggestion that the majority of conflicts can be avoided by allowing simultaneous explanations at different logical levels.

Does *Science and Christian Belief* work as a survey text? Probably not, unless it is supplemented with recent work in the history of science, where it is outdated, and some alternative theological perspectives, where it is narrow. But it does provide a helpful survey of a number of topics and an excellent introduction to the mind/body problem from both a scientific and a religious perspective.

There is one very large audience that I hope will read this book: the millions of American evangelicals who are convinced that a traditional conservative understanding of the Christian faith cannot be reconciled with a full acceptance of contemporary science, especially evolutionary theory. Precious few books address this issue, but this fine volume by Jeeves and Berry does.

KARL GIBERSON

Professor of Physics, Eastern Nazarene College
23 E. Elm Ave., Quincy, MA 02170

A Scientific Theology. Volume 1: Nature. By Alister E. McGrath. Grand Rapids, Mich.: William B. Eerdmans Publishing Co., and Edinburgh: T & T Clark Ltd., 2001. xx + 325 pages. \$40.00.

Alister McGrath titles the first volume in his trilogy with a word he quite dislikes: *nature*. Here is a postmodern evangelical, deconstructing everybody else and discovering the objectivity of his own Christian view: that “nature” so-called is really God’s “creation.” The latter word would have been a more accurate title than the much-dismissed “nature.”

McGrath is bright; this is a learned survey of historical ideas of creation and nature, as becomes an Oxford professor of historical theology. I envy his knowledge of the forming and reforming of ideas over many centuries. I am rather more sympathetic with “nature” but not unsympathetic with a version of his general project. I do something of the same thing myself. In fact, everyone who thinks his or her views are true has to argue away the myriad conflicting views as some kind of error.

Here is the argument in sum:

The present analysis will develop the argument that the concept of “nature” is a socially mediated notion, not an objective entity in its own right. Unless the potentially meaningless or conceptually fluid notion of “nature” is given an ontological foundation through the more rigorous Christian doctrine of creation, the continued appeal to “nature” is without intellectual justification or merit. The Christian doctrine of creation is perhaps the only viable means by which the notion of “nature” may be salvaged, and placed on a sustainable intellectual foundation. Without an ontological foundation, “nature” is simply one person’s construction and projection, and what is “natural” a restatement of that person’s own moral vision, which has been read into—and not out of—an ethically and philosophically amorphous world. (p. 87)

So McGrath is enthusiastic about what the social constructionists have revealed, exposing how the environmentalists have their agenda, whether conservationists, preservationists, or ecofeminists, and how the resource users, economists, and developers have theirs. “The concept of ‘nature’ is a serious candidate for the most socially conditioned of all human concepts” (p. 88). “One does not ‘observe’ nature; one constructs it” (p. 113). In “the book of nature” too “there is nothing outside the text” (pp. 110–21). The facts of science are theory-laden; all seeing is “seeing as” (Norwood R. Hanson, *Patterns of Discovery* [Cambridge: Cambridge Univ. Press, 1961]).

Different cultures have their different concepts of nature. The term is fluid, vague, plastic, and unstable. In the West especially, McGrath likes C. S. Lewis’s remark that nature is a term “we” (Western men) use to describe what we have mastered, and hence concepts of nature as a machine or feminine (pp. 105–10). “Yellowstone Park [a social construction] is not allowed to manage itself; it is managed by well-intentioned human beings” (p. 114, citing Alston Chase). Similarly with the American idea(l) of “wilderness,” defined as a place absent humans (p. 83). (Never mind that Lewis’s definition does not fit the environmentalists very well). Somehow even the Atlantic Ocean is constructed now that we fly over it in airplanes (pp. 114–15).

But wait; the natural sciences cannot be deconstructed so easily; they are a “serious headache” (pp. 121–24) for the postmodernists. So now, although those who speak of “nature” or “wilderness” are merely using constructs interpreting nature, the physicists and biologists are not; they are discovering what is really there. The natural sciences, McGrath could have noticed, do a good deal of constructing to help with their observing (constructing radio telescopes or relativity theory).

Even here McGrath is cautious: these physicists and biologists have a tendency to become “naturalists,” who think that nature both exists and is all there is; and if so they are constructing nature again. “In the end, naturalism is a *blik*” (p. 132), another socially constructed filter controlling the interpretation of all evidence and arguing away any possible counterevidence.

Nature is whatever we see it as, unless and until we see it to be what it really is: God’s creation. Yes, that too is an interpretive category, a “pair of spectacles” with which to look at the world (p. 137). We will then desperately need some account of why everybody else has only a projection, while Christians alone see correctly.

McGrath’s answer, beyond his appeal to revealed truth, includes the claim that the natural scientists also do see what is really there in the world: goodness, rationality, and orderedness, illustrated in the “unreasonable” (= marvelous) effectiveness and beauty of mathematics (pp. 209–14, 218–24, 232–40). There are “laws of nature” that are “universal, absolute, eternal, omnipotent” (pp. 225–32). “Simple laws govern almost all succession of events” (p. 220). A physical world of this kind known by a cognitive mind of the human kind is not self-explanatory but is a signature of God. With this “*logocentric* conception of creation” (p. 156), humans are imaging God, thinking God’s thoughts after him.

McGrath does think creation exists, and with its autonomy. “The explanatory autonomy of the created order is itself a consequence of its creation by God” (p. 171). Well, if so, then maybe to call that domain “nature” generically is not such a bad idea. Maybe some observers can see that autonomous order and integrity even if they do not see the “metaphysical fingerprints” (p. 172) that identify the Maker. Put a little differently, McGrath’s main claim is rather similar to that of Richard Fern in his *Nature, God and Humanity* (Cambridge Univ. Press, 2002), but Fern welcomes rather than dismisses the insights of secular thinkers who discover values in nature. Only he goes on also to argue that the biblical roots of these discoveries are unacknowledged and that without these roots the valued tree of life will not stand.

Tracing the intellectual history of an idea such as natural theology or evolution by natural selection and showing that there were connections with other social forces—dislike of ecclesiastical pomp led some to favor a simpler theology of nature; Darwinism fed into social Darwinism—does not ipso facto prove that the developing idea is a social construction, primarily explained as “shaped by the social agenda” (p. 248). McGrath knows this and at times can back off. “The position adopted in this study is not that the concept ‘nature’ is totally socially or culturally constructed, but that the notion is partly shaped by socially mediated factors” (p. 133). With the latter claim no one will disagree; all the disagreement will turn on how much and where. Despite momentary caveats, McGrath’s push is toward non-Christian “nature” as nothing but social construction. “The more fundamental difficulty is that the concept of ‘nature’ lacks the epistemic autonomy

required to permit it to be, or become, a theological resource in its own right. As we have stressed throughout this work, 'nature' is itself a construct rather than something which can act as the foundation for an ideational construction" (p. 257). The autonomy is withdrawn.

I would prefer to evaluate proposals about the nature of nature as the generating and testing of hypotheses, to be tested by all parties to the debate as much for their descriptive plausibility as mediated by social forces. A concept found in both theology and biology is "genesis," denied by none, but this bridge between nature and creation is not crossed here. "Earth" is another overlooked transept concept, but is Earth as constructed as nature is?

Whether McGrath likes it or not, there is an enormous body of knowledge about nature (the forces and processes generating and sustaining the enviroing world)—astronomical, geological, meteorological, and biological sciences that are autonomous from any legitimating biblical or theological oversight. Such science is not to be explained as mostly social construction, as he recognizes. These are "publicly accessible resources" (p. 300). This is, indeed, the line that McGrath promises to take in volume 2, *Reality*. Metaphysicians, theologians included, must look to this phenomenal world; and science is far more revealing about the detail of this than theology is. Nor, despite the theological claim that humans are epistemically fallen (pp. 286–94), is there any particular reason to worry that the sciences constructed by these scientists (astronomers, geologists, meteorologists, biologists) are epistemically corrupted by the fact that these scientists are also sinners.

Is there a natural theology? Yes—in the end; mostly no en route. "A natural theology, which sees nature as a creation, has an important role in a scientific theology" (p. 294). That is where we are headed, but most of those who have attempted a natural theology have to be dismissed before we can arrive at this conclusion. Now it seems that the Christians have wandered around in search of "natural theology" as much as have the philosophers and naturalists in search of "nature."

McGrath legitimates natural theology as a subdiscipline within his revealed (and "scientific") theology (p. 282), though why this should not rather be called "theology of creation" is obscure. Its place is not to prove that God exists but to reinforce the plausibility of an already existing faith (p. 267). The "neutral observer" (p. 284) cannot find any knowledge of God by studying nature. "It is only when the theologian has deconstructed nature—that is to say, identified the ideological constraints which have shaped the manner in which 'nature' is conceived—and recovered a Christian construal of the natural order that a proper 'natural theology' may be restored" (pp. 285–86). Everybody else has "constructed" an ideology, but Christians have a construal which sees the truth.

Of course skeptics will reply that one could just as plausibly say that Christians are biased by faith, and this looks equally like construction. Karl Barth denies natural theology when confronting the Nazis, and this looks as socially constructed as any other idea in the book (pp. 267–72).

There will not be any natural theology unless the Bible licenses it, and the Bible, which is without the word "nature," has only a weak natural theology; those who know Yahweh from the Torah can also find further glory of God in awe of creation (p. 259). McGrath minimizes the classical biblical passages that seem

to permit the Gentiles to have some knowledge of nature or nature's God (Paul on Mars' Hill adapted his rhetoric to his audience).

The concepts of chaos and disorder are discussed, revealingly, in a discussion of sin. McGrath wonders "whether the disordering to be discerned within the natural world . . . can be regarded as reflecting or resting upon a concept of sin." There is "emergent disorder within a primordially ordered cosmos." Following T. F. Torrance, McGrath holds that "the universe has fallen into disorder . . . and thus requires 'redemption from disorder'. . . . Sin affects the very fabric of creation. . . . The extent of this disordering is such that divine transformation of the cosmos is required to realign it with the divine intentions and goals—a transformation which is brought about through the death and resurrection of Jesus Christ, by which the 'reordering of creation' may be initiated" (pp. 289–90). "Redemption must be understood to embrace the whole created order, which has now fallen into disorder, and not simply humanity" (p. 176).

Two ideas here are not kept apart as well as they might be. One is that nature itself has fallen, which has some connection with sin. The other is that humans have fallen, and sin distorts their cognitive capacities when viewing nature. If nature has ontologically fallen, we would like to know when this took place, since on the evolutionary scale humans appear late, and the fundamental processes of nature—life and death, speciation, extinction, genetic coding, predation, ecosystemic food chains—do not seem to have altered with the arrival of immoral humans. There is no serious support in any science for a nature ontologically corrupted by any connection with human sin. The astronomical, geological, meteorological, evolutionary, and ecological processes are what they are and were so for millennia before humans appeared on the planet.

McGrath was once a biologist; we are reminded of his Oxford Ph.D. in molecular biophysics, and he cites his work in the field. Given that previous incarnation, for a "scientific theology" there is surprisingly little engagement with biology. One would never know that the human genome was being sequenced while this book was being written. "Gene" and "genetics" do not appear in the index; nor does "evolution," or "adapted fit." No reader could guess the main contentions either within biology or in the dialogue with theologians. The sociobiologists challenging religion with their selfish genes, such as Richard Dawkins and E. O. Wilson, are barely mentioned (pp. 252, 304); Elliot Sober and David Sloan Wilson defending the evolution of altruism are not here at all. Stuart Kauffman, John Bonner, and Christian de Duve exploring how nature is self-organizing—not here. John Maynard Smith, the best of theoretical biologists, on the origins of increasing order; Stephen Jay Gould, the most outspoken paleontologist, on the sheer contingency of evolution; Francisco Ayala, distinguished geneticist active in the biology/religion exchange—not here. Michael Ruse? Only in a footnote or two, in passing (pp. 31, 132). Ian Barbour, dean of the science-religion dialogue? Dismissed in a few paragraphs (pp. 38–39, 71).

McGrath celebrates the rationality of the physical world with its universal and absolute laws of nature. He does not address, indeed he does not seem to know, the widespread observation that in biology there are no laws of nature, only locally earthbound generalizations. Order mixes with disorder. Biology is not elegant—so Frances Crick has complained. What is one to say of messy phenomena such as the catastrophic extinctions? or of the balanced polymorphism that trades

off protection against malaria at the price of liability to sickle-cell anemia? The theodicy in Mark Wynn's *God and Goodness* (Routledge, 1999) takes suffering in creation far more seriously.

Reading McGrath, one would not know that one of the surprising developments in biology over the last quarter century has been the intense advocacy by biologists for conservation in the midst of a biodiversity crisis. The natural scientists have been as ready to be nonanthropocentric as the Christian theologians have; the Society for Conservation Biology has been better at this than has the World Council of Churches.

Despite my misgivings, I found McGrath stimulating and insightful. "There is a fundamental resonance—but nothing more—between nature and theology, with the latter offering a prism through which the former may be viewed and understood" (p. 295). Yes, nature is not finally self-explanatory or "self-authenticating" (p. 295). Christians do have a prism that diffracts, analyzes, and enlightens what scientists and naturalists discover. But theology that is not diffracted by their discoveries is unenlightening about nature.

HOLMES ROLSTON, III
 Department of Philosophy
 Colorado State University
 Fort Collins, CO 80523

Faith, Science and Understanding. By John Polkinghorne. New Haven and London: Yale Univ. Press, 2002. 224 pages. \$19.95 (\$12.95 paper).

In the Preface, John Polkinghorne describes this book as a "further thoughts" volume, looking again at some of the issues raised in four of his more recent books. It consists of nine relatively short chapters; two of these are further subdivided, so that there are fifteen separate pieces in all. The close link with his earlier work is illustrated by the fact that there are more than sixty references in the footnotes to earlier writings of his own. The nature of those links is not uniform. Some of the pieces are based on talks given, sometimes to a fairly general audience, and take the form of a broad presentation of some major aspect of his thought. Others were written specifically for this volume and take up particular points that he feels need further development or clarification.

In reviewing a book made up of so many short pieces of a somewhat diverse nature, it is impossible to comment on each one. That is a relief for me, since several of the shorter ones are concerned with the precise way in which recent scientific ideas are best to be understood, on which I as a theologian am not competent to speak. (Indeed other theologians with more scientific competence than I have might also hesitate to do so, seeing how sharply Wolfhart Pannenberg is taken to task for his use [or misuse] of scientific concepts.) But Polkinghorne was, as he acknowledges, trained primarily as a scientist, so there is a *prima facie* likelihood that it may be on the theological side of his interdisciplinary investigations that questions need particularly to be asked. I discuss just three issues that figure prominently in this collection and that seem to me to call for further consideration.

1. Polkinghorne emphasizes the need for a “natural theology” which shows how the understanding of the world to which modern scientific study has given rise leaves scope for, and even invites, other forms of reflection of a theological kind. I find his general handling of this familiar but important topic helpful and convincing. The basic character of his position is neatly summed up in his observation that a Grand Unified Theory is not the same as a Theory of Everything. More detailed aspects of his arguments, such as whether he is right to relate the openness of the physical world to quantum theory, chaos theory, and complexity theory rather than to Einstein’s conception of the finite but unbounded nature of the universe (against Torrance, p. 175), and the openness of history to the ideas of the top-down effects of active information rather than to field theory (against Pannenberg, p. 167), I leave to others to judge. But the nature of the discussion is further to be commended for the modesty of its claims. The evidence does not prove the rightness of a theological account; it only allows it as a reasonable possibility. Nor does it favor a Christian theology over against other religious interpretations of the world (pp. 49–51, 65). His treatment of the question of Christianity’s relation to other religions is brief but sensitive. What is surprising is that it seems to have no impact on his understanding of Christian theology.

2. A second major theme in these writings is the nature of theological study as compared with the study of science. Polkinghorne describes himself as a “bottom-up” scientific thinker, working in a characteristically English empirical tradition and with an understanding of the physical world best described by the term *critical realism*. Theology, he believes, should follow a similar method, though one must expect some differences arising from the differences between the subject matter of the two disciplines. I would endorse this as a general statement of method, but it still leaves a lot of room for disagreement about the nature and the extent of the differences entailed by the differences of subject matter. And on that score I find myself parting company with him.

The Bible, as he understands it, is not a divinely dictated textbook but “*evidence*, the record of foundational spiritual experience, the laboratory notebooks of gifted observers of God’s way with men and women” (p. 37). Theologians need to wrestle with this evidence in ways comparable (but not always identical) to the ways in which scientists wrestle with theirs. One example of his own readiness to do so in a fully critical manner is his description of the prose sections of the Book of Job as not using “the language of responsible theological discourse at all” but operating with the “concept of a disturbingly ‘tricksy’ God.” They cannot, he concludes, be as “authoritatively revelatory” as the poetic sections of the book (p. 63). So when elsewhere (p. 58) he speaks of “revelation as evidence” we have to remind ourselves that this is a loose way of speaking, since we have first to judge which parts of the evidence in our laboratory notebooks are revelatory and to what extent.

Here, he suggests, the creeds (which are compared to the data tables of the particle physicists, though unlike them not subject to change) may help us. They are not “non-negotiable formulae presented for us to sign without hesitation or question” but are summaries of the early church’s reflection on scripture staking out the “territory in which a faithful theology is free to roam” (pp. 38–40). One of the results of the differences between the two disciplines’ subject matter, he

argues, is that theology is not a cumulative discipline like science, which “conquers intellectual territory it will not have to give up.” And the reason this is so is because theology’s “Subject transcends human observers; the transpersonal reality of God is not open to our manipulation or putting to the test” (p. 39). That there are differences between the way theologians and scientists test their theories and that those differences are for the kind of reason he affirms, I fully agree. But I question whether he has identified those differences aright. The theologian’s evidence is, as Polkinghorne himself recognizes, not the transcendent God but “the record of foundational spiritual experience,” and that human record is always and inevitably affected by the understanding of the world at the time. So changing understandings of the world make theologians read their basic evidence differently. They may, for example, come to judge the creeds to be a less satisfactory summary of scripture than they have been judged to be in the past. “The autonomy of theological thinking within its own proper domain,” which Polkinghorne cites with approval from Torrance (p. 179), is at risk of losing sight of the historical, earthbound character of its foundational evidence. And that can lead to a failure to follow out sufficiently rigorously the kind of critical evaluation of theological evidence that Polkinghorne’s own underlying theological method calls for, and so to fight shy of the kind of theological revision toward which it naturally points.

3. The third major issue is a particular instantiation of those more general methodological considerations—namely, divine action in what is generally called “special providence.” Polkinghorne is well aware that divine actions of this kind are not easily explicable in relation to the physical world as science understands it, but he is equally convinced that they are integral to Christian belief. Such difficulties, however, are not absolute. “The cloudy unpredictabilities of created process,” as we are beginning to understand them, allow for specific divine agency to be “exercised as a cause among causes,” without overruling the acts of creatures (p. 127). More than one feature of the current understanding of the physical world might be understood to provide the occasion for such a form of divine action; his own preference is for what he styles principles of “active information” (p. 148). He admits that this is highly speculative but is content to be able to show that the idea of such particular divine actions is not incompatible with modern scientific knowledge.

Not being a scientist, I am not competent to assess the plausibility of such speculations. Polkinghorne himself points out the shortcomings of earlier attempts by William Pollard and others to use quantum theory in a similar way to account for divine action at the macroscopic level (p. 120), and I would have liked more explanation as to how the causality he proposes could serve to explain the kind of instances of special providence he has in mind. What I miss even more, as a theologian, is any discussion as to whether the traditional affirmation of special providences initiated by specific divine actions might call for reconsideration. For a bottom-up thinker committed to critical evaluation of the basic biblical evidence, this would seem to be an issue in need of reflection. Divine speaking, for example, is a common feature of the biblical record; yet most Christians give it a far from literal interpretation. Ought not the possibility that something similar might be appropriate for the notion of specific divine actions merit more than a simple dismissal as a sign of theological impotence (p. 146)?

There is a further problem about the apologetic value of this speculative account of how divine action might responsibly be seen as “a cause among causes” in the physical world. Polkinghorne admits that, in addition to affirming divine action in cases of special providence that might otherwise be treated as examples of serendipity, he is committed, in view of the centrality of the resurrection, to the affirmation of miracle (pp. 43, 59, 128, 190–91). He does not give any detail here of his understanding of the resurrection, but from his earlier writings it is clear that, while not regarding it as a straightforward case of resuscitation, he does see it as involving among other things the disappearance of the physical body from the tomb. A miracle of that kind can hardly be accounted for by the means that he proposes for divine actions in general; nor does he suggest that it can. What he emphasizes here (and in his earlier writings) is that miracle stories are to be assessed and their “*theological* credibility” (p. 191) affirmed by the degree to which they are consistent with our broader understanding of God’s purposes. That is a fully appropriate stress for determining the theological and spiritual value of a miracle story. But the fact that the resurrection is an anticipation of the Christian’s eschatological hope does nothing by itself to help us see how it is to be integrated into our understanding of the physical world—the quest that he pursues so unrelentingly in the case of special providence. Nor does Polkinghorne’s suggestion that there may be an analogy with the way scientific investigation of unexpected and puzzling physical phenomena sometimes requires explanations that cannot immediately be related to already familiar phenomena strike me as very convincing (p. 59). So, whatever be the truth of his speculative suggestions about special providence, there is still a crucial gap in his attempted account of divine action as a whole.

Polkinghorne’s project of integrating our understanding of science and theology has many strengths and has made a valuable contribution to a better approach to the topic. But even with the fine tuning attempted in this volume, it still has some major difficulties. My conclusion is that he needs to give greater weight to the “critical” part of his critical-realist approach to theology than he is inclined to do. As with changes of scientific paradigms, what at first seems like a repudiation of past ideas and is strongly resisted as such may turn out in the long run to have a much more positive relation to earlier views than was at first apparent. It would be surprising if a critical-realist approach to understanding the transcendent God should not prove to be a very faltering one, in need of frequent revision.

MAURICE WILES
Regius Professor Emeritus of Divinity
Christ Church, Oxford

Physics and Metaphysics: Theories of Space and Time. By Jennifer Trusted. London and New York: Routledge, 1991. xii + 210 pages. \$114.95.

Jennifer Trusted introduces the book's theme in a preface by asking "What is metaphysics?" According to Aristotle, she explains, metaphysics describes that which is beyond the scope of physics, such as presuppositions that cannot be established by scientific inquiry. She then states her intention to show that presuppositions, speculative conjectures, and even mystical beliefs are nevertheless important—in fact essential—to natural science.

While the early chapters describe the influence of the Christian religion, later sections emphasize the importance of philosophical developments on the emergence of science in Europe. Trusted shares her conviction that the influence of Christianity on science even today should not be underestimated: "There is more to the relation between religious faith and scientific inquiry than the apparently contingent fact that many scientists have been motivated by their religion and that some Christian clergy have been scientists. Certain fundamental tenets of Christian doctrine support presuppositions that have been, and still are, of prime importance for science" (p. xi). She provides several interesting examples.

The first chapter, "The Ordered Cosmos," begins with a discussion of the tenets of medieval Christian Scholasticism. Scholastics demanded teleological explanations of physical events—that is, ultimate explanations in terms of divine purposes. Knowledge about the natural world was to be obtained through study of the scriptures and "authorities" only. The second chapter, "Old Beliefs and New Ideas," describes the eventual rejection of this tradition in the course of the historic struggle between proponents of Ptolemy's geocentric cosmology and Copernicus's heliocentric system. Chapter 3, "Chaos," details the turmoil that resulted from Galileo's conflict with the Roman Catholic Church. While the Bible continued to be regarded as an infallible source of knowledge, the role of the church as its sole interpreter was no longer unquestioned. The author notes the importance of Galileo's introduction of careful observation and experimentation and Kepler's description of natural phenomena in terms of mathematical laws.

Chapters 4 and 5, "The Search for a New Order" and "The Grand Design," deal with the influence of Descartes and Newton, who agreed with Galileo that the book of nature would be in accord with scripture assuming that both are properly interpreted. But, according to Descartes, humankind should not seek the impossible, namely, the discovery of God's purposes. Teleological explanations hence were abandoned and causal laws of nature accepted as ultimate explanations. The universe became a machine that functioned according to physical laws—with one exception: the human soul. This Cartesian dualism led to a fundamental dichotomy between science and religion.

Concerning epistemology, the rationalists Descartes, Leibniz, and Spinoza believed that knowledge of nature could be obtained by reasoning alone. The British empirical tradition, by contrast, held that sense experience was essential for such knowledge. Because sense experiences are limited and fallible, however, Locke admitted that natural philosophy could not yield indubitable truth. At any rate, the pretense of basing knowledge of nature on divine revelation ended, and human reason and observation became the sources of human knowledge.

At the close of the seventeenth century, through the discovery of the laws of motion and universal gravitation and the great successes of celestial mechanics, order had come out of chaos. Philosophers still accepted God as the original cause of all motion but disagreed on God's present activity in the world. Leibniz concurred with Francis Bacon, who stated, "God worketh nothing in nature" (*Advancement of Learning* [1605], Book I), while Newton firmly believed that God's omnipresence and eternity implied God's immanence and occasional direct interventions in space and time.

Chapter 6, "The Age of Reason," states that in the opinion of eighteenth-century British natural philosophers the cosmic order and laws of nature reflected divine harmony and constituted proof of the existence of God. Reason hence replaced revelation, and natural theology flourished. But whereas the idea of a divine Creator was accepted, the new philosophy had no place for God's "providence" or "salvation." Deism superseded Christianity. As explanations of events were sought in terms of purely physical laws, natural philosophy became associated with materialism. French philosophers denied the existence of an immaterial spirit and declared that the human being is a machine. The earlier latent secularism became explicit and the exclusion of God from scientific explanation total. This marked the start of the conflict between science and religion.

The eighteenth century also witnessed challenges to the power of human reason, in particular Hume's skepticism about the reliability of empirical knowledge. Immanuel Kant conceded that we cannot know ultimate reality and suggested that "instead of all our knowledge conforming to objects, let us suppose that all objects conform to our knowledge" (*Critique of Pure Reason*, ed. and trans. N. Kemp-Smith [London: Macmillan, 1929], 22).

Chapter 7, "The Age of Experience," discusses the emergence of science from natural philosophy at the end of the eighteenth century. The rationalist criterion of knowledge—logical certainty—had been rejected, but confidence remained that sense perception could be truly objective and independent of theory. The positivism of Comte in France and Spencer in England turned into a philosophy which promised that all knowledge was attainable through scientific inquiry.

In Chapter 8 the author tackles the problem of "Energy and Aether." For Descartes the aether was a logical necessity—the medium required for the propagation of light waves through space. Newton, convinced of the corpuscular nature of light, considered it an empirical hypothesis. Maxwell's identification of light as an electromagnetic wave led to the general acceptance of the luminiferous aether. Chapter 9 discusses the subsequent "Revolution" in physics at the beginning of the twentieth century as physicists such as Michelson and Morley failed in their attempts to detect the aether. The author traces the story of the rejection of the concepts of absolute space and time and briefly introduces Einstein's special relativity theory. The space-time concept and the dependence of an observer's measurements on his frame of reference are explored.

In the final chapter, "Physics and Metaphysics," Trusted returns to her stated goal: "to show that metaphysics plays an essential role in empirical inquiry." She focuses on the remarkable changes in Einstein's own views of science. The theoretician Einstein started out as a positivist but later came to appreciate the importance of imaginative conjectures. In conclusion, the author mentions Hawking's book *A Brief History of Time* and his apparent need to repeatedly appeal to a

power that transcends human capacities in order to account for the existence of the universe.

To summarize, *Physics and Metaphysics* focuses on the history of the developments of the concept of inertial motion, Newtonian mechanics, the conservation laws of energy and momentum, some elements of electromagnetism, and special relativity theory. Einstein's theory of general relativity, however, is essentially omitted, and in that sense the book's subtitle, *Theories of Space and Time*, is somewhat misleading. Even more significant are the omission of quantum physics and of recent discoveries such as chaos theory, together with their philosophical and theological implications. Critiques of the traditional scientific method by, for instance, Kuhn and postmodern thinkers also are missing. Perhaps such topics could be included in a future edition of this otherwise well-balanced work.

The book's nontechnical nature (no mathematical formulae appear in the text) should make it accessible to a wide audience. At the same time, readers must be cautioned that this volume cannot be considered an introduction to, say, the elements of special relativity theory. Some prior study of physics is helpful for a fuller understanding. The book provides concise end-of-chapter summaries that students will find very helpful as an overview and reference frame for discussion.

In the opinion of this reviewer, Trusted has succeeded in showing that the basic metaphysical assumptions of Aristotle, of Scholasticism, and of classical and modern science are still with us today. The author's careful documentation of the rich interaction between science and religion over several centuries is particularly valuable. I warmly recommend this book. It should be of particular interest to students and teachers of science. It is unfortunate that, at present, the education of most scientists does not include sufficient opportunities for the study of the history and philosophy of their subject matter. Trusted's book—which also seems entirely appropriate reading for an undergraduate course on the relation of science and religion—could contribute much to a better understanding of the metaphysical underpinnings of natural science by the practitioners of science and, hence, to a more sophisticated discussion of the role of science in society today.

Jennifer Trusted is the author of several books on the philosophy of science, including *The Logic of Scientific Inference: An Introduction* (London: Macmillan, 1979) and *Beliefs and Biology: Theories of Life and Living* (London: Palgrave Macmillan, 2003).

H. MICHAEL SOMMERMANN
Professor of Physics, Westmont College
Santa Barbara, CA 93108

Controlling Our Destinies: Historical, Philosophical, Ethical, and Theological Perspectives on the Human Genome Project. Edited by Phillip R. Sloan. Notre Dame, Ind.: Univ. of Notre Dame Press, 2000. 535 pages. \$50.00 (\$20.00 paper).

Publication of this multi-authored volume on humanistic implications of the Human Genome Project (HGP) in the same year as the announcement of virtual completion of the project was especially timely. The anthology of essays contains a wealth of information and ideas valuable to scholars, teachers, and laypersons

wishing to participate constructively in the dialogue about appropriate societal responses to the new powers with which our species is being endowed.

Phillip Sloan is Director of the J. Reilly Center for Science, Technology and Values at Notre Dame, which along with the Department of Energy ELSI (Ethical, Legal, and Social Implications of the HGP) Program sponsored a 1995 conference at the University of Notre Dame for discussing humanistic implications of the HGP. This book is the published version of that conference. Sloan has provided an introductory article and edited twenty other contributions, fifteen essays and five accompanying commentaries, by twenty-three authors. The book has four parts: (1) Origins of the Genome Project, (2) The Genome Project and Eugenics, (3) Is a Strong Genetic Reductionist Program Possible? and (4) Reductionism, Determinism and Theological Humanism. Contributors include pre-eminent philosophers, theologians, scientists and historians of science from France, Great Britain, and the United States: John Beatty, Robert Bud, Arthur L. Caplan, Alice Domurat Dreger, Kevin FitzGerald, Jean-Paul Gaudilliere, Jean Gayon, Marguerite Hays, Lily E. Kay, Evelyn Fox Keller, Philip Kitcher, Timothy Lenoir, Edward Manier, Richard A. McCormick, Ernan McMullin, Timothy Murphy, John M. Opitz, Diane Paul, Arthur Peacocke, Martin S. Pernick, Hans-Jorg Rheinberger, Kenneth Schaffner, and John Staudenmaier.

My professional training is in cell biology, so this review does not stem from special expertise in any of the humanistic disciplines represented by the contributors. I undertake it because of an interest in the interface between science and the humanities nurtured for several years by involvement in an interdisciplinary, undergraduate world history program that examines connections between the "two cultures." I know what a genome is and basically how genes and other cell parts work, so at least I am able to judge whether the humanistic perspectives expressed in this book are rooted in an accurate understanding of the relevant science. At most I can give a biologist's evaluation of some of those perspectives and the clarity with which they are expressed. Although even a cursory review of every essay would be impractical, I will comment on several that I found insightful, provocative, or especially informative. I also include opinions about the balance of subject matter contained in the book and the collection's usefulness to scientists and teachers.

In June 2000, Francis S. Collins and J. Craig Venter, leaders of the public and private sectors' genome sequencing efforts, respectively, announced virtual completion of the project which originally was not expected to be finished until 2005. That the conference at which the papers in this book were presented occurred five years earlier in no way diminishes its relevance to the social issues that completion of the HGP thrusts before us now.

How humankind as heirs of the scientific revolution and the Enlightenment and/or the United States as a modern democracy came to commit itself to the HGP are subjects addressed by Sloan's introduction, "Completing the Tree of Descartes," and of essays in Part 1.

Sloan carries the reader from Descartes' dualistic view of humankind (transcendent mind separated from material body, with the latter understood as a hydraulic machine subject to the laws of a mechanistic physics) through eighteenth-century vitalism and ultimately to the emergence of a new form of reductionism for nineteenth-century life science. Sloan argues that although the

nineteenth-century developments bore no immediate historical connections with the Cartesian project they retained striking conceptual resemblances to it. An experiment-based, chemical-physical explanation for body heat via the work of Lavoisier in the 1770s and '80s presaged the statement by Emil Dubois-Reymond, a biophysically oriented, late-nineteenth-century medical physiologist of the Berlin Physical Society, that "no other forces than the common physical-chemical ones are active within the organism."

Reducing the biological to the physical has continued to be a hallmark of the modern reductionist program in the life sciences. Twentieth-century manifestations of that program include the biochemical characterization of metabolic pathways, the discovery of double-stranded DNA structure, and the HGP itself. Sloan acknowledges the great potential of the HGP to provide a bounty of medical benefits for humankind. But he is unsettled by the presumption of many scientists and self-anointed explainers of science to the general public that the reductionist program in biology and molecular biology in particular will ultimately be able to explain humankind's theological bent and provide a full explanation of self-reflective consciousness in purely physical terms.

Digesting the final eleven-page section of Sloan's essay subtitled "Genomics and Reductionism" was difficult for a mere scientist but became possible with the aid of the *Routledge Encyclopedia of Philosophy* after the third or fourth reading. In this section Sloan argues for a return to Descartes' metaphorical tree of human endeavors in order to recall that Descartes placed (properly so, says Sloan) theological/human consciousness issues at the root of the tree. He viewed these as reflecting a priori preconditions for the mechanistic, reductive science that forms the trunk of the tree and from which emerge the various branches of knowledge: medicine, mechanics, and ethics. Via tortuous paths, Sloan sides with Descartes in arguing that knowledge about theological issues and the reality of humankind's reflective nature are not subject to causal analysis via the scientific method. Although Sloan never says so directly and with clarity (at least for me), the title of his essay appears to refer to the opportunity that modern molecular biology and strong reductionism in the other sciences have for adorning the tree's branches with fruits, elements of the metaphor that Descartes' early death at 54 prevented him from fully developing. None of these will be metaphysical fruits, though, and none will show us the meaning of our existence or the values that we should embrace, according to Sloan. "Returning to Descartes' Tree" would have been a more apt title for this essay, because most of Sloan's effort is an attempt to persuade us that "wisdom emerges not out of our physics and biophysics, but from our recognition of our science as a product of human consciousness reflecting upon itself" (p. 26). Although hard-core sociobiologists and strict materialist neurobiologists will find many points for disagreement in this essay, it does very nicely frame many of the philosophical, theological, historical, and ethical issues addressed in detail by other authors in subsequent essays.

Of the five essays in Part 1, the first and last were my favorites. In "The Manhattan Project for Biomedicine," Lenoir and Hays tell of the continuity between the government's atomic bomb project of the 1940s and today's public HGP. With interesting historical details and in clear prose, they explain how the U.S. government purposefully transferred resources and personnel after World War II from a nuclear bomb effort to a nuclear biomedical effort that included

the development of radioisotopes for biology, radiopharmaceuticals, bioinstrumentation including scintillation counters, and establishment of the discipline of radiological safety. Along with this massive and successful government technology transfer came incentives for involvement of private industry and public universities in biomedical research. The Atomic Energy Commission and biomedical elements of its founding charge in 1946 drove this transfer of technology. Although the HGP of the 1980s was a natural outcome of the redirection of national attention toward biomedicine forty years earlier, a selling job still had to be done on the public and the scientific community before the HGP could be legislatively established as a national scientific priority akin to the moon project of the 1960s. How this was accomplished is the subject of Dreger's wonderfully revealing and very readable "Metaphors of Morality in the Human Genome Project." The essay reveals how proponents of the HGP managed to make it patriotic to support the endeavor and unpatriotic to oppose it. Although many scientists advanced reasonable arguments that allocating billions of dollars to the HGP would cripple many other areas of basic and applied biological research, proponents of the program won the day by appealing to Americans' pioneer penchant for conquering frontiers and our hearty willingness to root out and destroy "bad things"—in this case, disease-causing genes. Reproductions of cartoons playing/preying upon these inclinations as well as one satirizing this approach (i.e., James D. Watson draped in the red, white, and blue) add an effective touch to this essay.

All three essays in Part 2 on eugenics are excellent and accessible to readers from all disciplines. By reviewing the history of the eugenic movement in the U.S. in the first third of the twentieth century, Pernick's "Defining the Defective: Eugenics, Esthetics, and Mass Culture in Early Twentieth-Century America" sounds a warning for future eugenic programs that may make use of diagnostic and therapeutic techniques emerging from the HGP. He argues convincingly that decisions on what constitutes beauty or genetic defectiveness are largely value-based and controlled by the mass media, leaving the door open for racial, gender-based, and ethnic prejudices to drive eugenic decisions. "Do esthetic values create disability, in the same way that high stairs and other physical barriers do?" Pernick asks (p. 208).

Caplan's "What's Morally Wrong with Eugenics?" categorizes eugenics in two ways: negative vs. positive and individual vs. population. After discussing the outlook for selectively eliminating early embryos on the basis of their genetic constitution (negative eugenics), the purposeful alteration of the genetic information in germ cells (positive eugenics), and the terrible consequences of coercive, government-sponsored eugenics (population eugenics), Caplan defends the right of individual couples to strive for the "perfect child" by whatever legal, noncoercive means technology offers (individual eugenics). Several arguments against this position are addressed by Caplan, who maintains that overriding all of these is the "right to reproduce without interference from third parties [as a] fundamental freedom recognized by international law and moral theories from a host of ethical traditions" (p. 219).

The final essay in this section, "Utopian Eugenics and Social Inequality" by Philip Kitcher, is the most startling and the most morally challenging of the three. It is startling because the reader is made to realize that whether to practice eugenics is not optional because "once we know how to identify . . . genotypes of future

people, eugenics is the only option . . . once we lose our genetic innocence, we have alternatives, and, because we have to elect one of the alternatives, we have to practice eugenics" (pp. 237–38). It challenges societal morals by asking, "why should we rush [to develop gene therapy procedures] to treat the unfortunate genetic inheritance of the few, while ignoring the unlucky social inheritance of the many? Shouldn't we commit ourselves to change the environments that break young lives as surely as defective proteins?" (p. 240) Kitcher maintains that there is no reason to believe that the medical benefits of the HGP will be any more justly distributed among those in need of them than are other resources now such as food, shelter, and education opportunities. Which should receive priority—research for genetic therapy for the few or a commitment to allocate our present resources to bringing nearly everyone's expected quality of life to a minimal level? For Kitcher, a utopian eugenics is premised upon freedom of reproductive choice for all and can occur only if all infants born with debilitating genetic conditions are offered the best support available and are assured that they can live their lives free of social prejudices.

Two essays and accompanying commentaries constitute Part 3, on the outlook for a strong genetic reductionism—the notion that we can understand organisms, including their physiological functions, heritable disease states, and behavior by studying their genes. These contributions disappointed me. The first, "Is There an Organism in This Text?" by Keller is a history of the metaphors used to describe the unit of heredity, beginning with the pangens (minute particles in germ cells) of Hugo DeVries (1889) and ending with Henri Atlan's (1990) "multi-layered parallel computer network" (quoted on p. 289). Keller was educated as a physicist and now writes about the history of biology. This contribution complements that of Kay's history of molecular genetics in Part 1 and would more appropriately have been placed there.

The second by Schaffner, a philosopher and M.D., argues against the prospect for a strong genetic reductionism. To bolster his view, Schaffner points out that even in one of the simplest and most thoroughly studied multicelled organisms, the 959-celled roundworm *Caenorhabditis elegans* with an entire nervous system comprising just 302 neurons, behavior is very difficult to characterize in terms of the activity of specific genes. One of eight reasons cited for this is the so-called *many-genes one-neuron* rule, meaning that the coordinated activity of many genes is required for the existence of a single neuron. The implication is that the complexity of gene expression that must be required to build and sustain neural networks in even the simplest organisms defies an exhaustive genetic analysis of the behavior that emerges from those networks. Schaffner is right that many genes are required to produce a single neuron; in fact, this is true for any type of cell, and the number of genes is more than "many"; it is thousands. The majority of these genes are "house-keeping" genes whose activity is required for the life of any cell. The number of genes whose action make one cell type different from another cell type is relatively small by comparison. Furthermore, an electrician does not need to understand the behavior of every electron in every wire in order to accurately read a circuit diagram or even to modify the diagram so as to alter the function of a device. I am not as doubtful as Schaffner is about the prospect for understanding neuroanatomy and behavior in terms of gene action. Consider the exponential growth of our understanding of living systems and the technolo-

gies for their analysis over the past thirty years. No one predicting in 1970 that an HGP would be undertaken and completed before the turn of the millennium would have been taken seriously. And at the inception of the HGP in the mid-1980s, no one foresaw the microarray technology that now allows patterns of gene expression to be analyzed in single cells or the formation of a new discipline called proteomics whereby the complex interactions of the protein products of gene expression will be made to give up their secrets. Balance of outlook in this section could have been obtained by contributions from a practicing molecular biologist and a sociobiologist.

The five essays in the final section of the volume take up theological questions emerging from the HGP, questions that in one way or another ask what it means to be human and what might be the limits of science in understanding human life in all of its dimensions. Some are more direct about it than others, and the approaches vary, but each author in this section seems to be either attempting to leave room for God in humankind's odyssey or presuming God's presence in moral theologies. At the same time, there is no hint that any one of the authors doubts our origin through naturalistic, evolutionary processes or our aliveness due to nonvitalistic phenomena whose details will become increasingly revealed by information emerging from the HGP. FitzGerald's paper on philosophical anthropologies is an inspired discussion of the critical importance of our approach to understanding human nature when developing ethical systems to guide the use of biotechnologies that themselves may be applied to the purposeful sculpting of human nature. McCormick's piece on moral theology contains a wonderful 1982 quotation from the U.S. House of Representatives which highlights the concern voiced earlier by Kitcher about national priorities and social justice: "Most countries of the world can afford little or nothing for elaborate genetic research. In this country, what resources should go into genetic therapies that may some day cure cancer as compared with correcting environmental causes of cancer that are operational right now? What resources should be assigned to research into the unknown as compared with correction of nutritional deficiencies for which answers are available now?" (p. 425) The relevance for the global community of some of McCormick's other points, such as his discussion of abortion and genetic discrimination, seem handicapped by their decidedly Roman Catholic Christian perspective. In other spots, however, he sets a high standard for Christian dialogue on thorny bioethical issues by suggesting that Christian emphases and tradition are more useful as value raisers than as answer givers.

Opitz, a clinical geneticist, believes that medical schools need to do a better job of reminding future physicians that despite the many recent discoveries in molecular biology, the ethical basis of medicine has not changed. This would be a worthy point were it not presented in the context of his view that abortion of genetically defective fetuses amounts to the wrongful disposal of a defective part of the mother. He even likens therapeutic abortion to the excision of Native Americans, Jews, and other ethnic subpopulations from society via butchery by a more powerful element in the population. Near the essay's end Opitz makes the more constructive comment that the eugenics to be made possible by the HGP may necessitate a need for an international panel of ethicists to review national policies toward the genetically defective. The means for selecting members of such a panel and for enforcing its recommendations, however, are not discussed.

Emergentism and its theological implications are the foci of Peacocke's and McMullin's essays. The term *emergence* was coined in 1875 by G. H. Lewes. It refers to a higher-level property of a system being irreducible by the natural laws governing the constituents of a lower-level property from which it is derived. The term appears often in the current literature on human consciousness. For example, an emergentist would maintain that self-reflective human consciousness is not understandable solely from the biology governing the lower-level properties of synapses and neurotransmitters upon which it depends. Emergentism may also be invoked in the physical sciences; but these authors apply the concept in discussions about the soul and humankind's relationship with God ("soul" and "God" left undefined). When brain became mind, mind became instilled with soul, and soul entered into communion with God during the evolutionary process need not be issues for emergentists, according to McMullin, if the Creator is seen as sustaining a natural order of causes and effects producing higher and higher levels of existence and ultimately the emergence of soul. And Peacocke, who sees intention and purpose through evolution without determination, observes that "it would be unwise to place too much hope in the ability of any directed genetic engineering to ameliorate the general human condition, especially the psychological and spiritual" (p. 365). I found both essays intriguing but was left yearning for a contribution from a sociobiologist invited to speculate on the ultimate relevance of the HGP (and proteomics) for understanding humankind's religious inclinations. Also, since the DNA of humans differs only one percent from that of chimpanzees, I cannot help but wonder what the identification of the structure and function of the genes containing these differences might soon tell us about human consciousness and spirituality.

The greatest strength of this collection is that it contains excellent pieces for nearly everyone. Dreger's and Caplan's essays are beautifully written and ideal for undergraduate students. I know from classroom experience that the provocative information contained within them, and their focus on the science-media interface and the science-morality interface, respectively, stimulate vigorous and constructive discussion among freshman to senior-level students who have read the articles. Graduate students and scientists in molecular biology will benefit by reading about the origins of their discipline in the essays of Lenoir and Hays and of Kay. Pernick's piece should interest social scientists, clinical geneticists, and genetic counselors; moreover, the material is very appropriate for undergraduate students and even junior/senior-level high school students. For persons with theological interests working in any discipline, I recommend the contributions of McMullin, McCormick, and Opitz. Using the entire volume for a graduate seminar course on twenty-first-century biology and human values with professors from diverse disciplines present to lead the discussion would be great fun.

JAMES T. BRADLEY
Department of Biological Sciences
Auburn University
Auburn, AL 36849