CHAPTER ONE

# Concepts of Law and Probability in Theology and Science

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The task of this initial chapter is to open up issues that others will explore more fully in succeeding chapters of the present work. In the following introductory overview of the topic I will examine the concepts of "law" and "probability" and related concepts, and in particular show how they are used in different ways in theological and scientific discourse. I will also indicate how concepts such as law and probability have arisen in various different scientific domains, and how they play an important role in the interface between science and theology. In the final section I offer an outline of the succeeding chapters of the book.

## Lawfulness and Related Concepts

The concept of the lawfulness of nature underwent a significant revision in the Enlightenment period, and came to have overtones of determinism that it had not had before. As Peter Harrison explains in Chapter Two, the concept of "laws of nature" is one that we have inherited from the seventeenth century. As he says, it was a concept that was initially introduced on the basis of theological presuppositions, though these original presuppositions have now largely been abandoned. I would additionally suggest that the seventeenth-century concept of the laws of nature in their turn worked back upon theology, and contributed to a theological change of direction. For example, miracles began to be defined in contra-distinction to the lawfulness of the natural world, in a way that had not been so explicitly a feature of earlier thinking.

It is one of the interesting developments in recent philosophy of science that the concept of lawfulness has once again become more flexible, less rigid than it was in early modernity.[1] Indeed, this change in the concept of the lawfulness of nature is perhaps one of the hallmark changes between modernity and post-modernity. These recent changes in the concept of lawfulness have significant implications for theology. In Chapter Three, Philip Clayton distinguishes three broad views of the laws of nature, as expressions of divine choice, eternal necessities, or regularities discerned by humans. The latter two are both very much in play in secular thought, but I suggest that a shift can be discerned towards the latter view.

1 N. Saunders, *Divine Action and Modern Science* (Cambridge: Cambridge University Press, 2002).

A softer view of the laws of nature can make it easier to see how divine action can be reconciled with laws of nature without those laws being violated. For example, an instrumentalist view of the laws of nature does not see those laws as something that divine action might overturn. Almost everyone who has written in recent years about the relationship of the lawfulness of nature to God's action in the world has wanted to find some reconciliation of the two that avoids the kind of interventionism in which laws are violated. A softer view of the laws of nature is one way of achieving that reconciliation.

It is worth acknowledging here that theologians are pulled in conflicting directions about the laws of nature. There is a tension between wanting to emphasize the lawfulness of nature as a reflection of God's faithfulness, and wanting to emphasize the openness of creation as reflecting God's continuing initiative. Those drawn in the first direction would sympathize with Einstein's comment that "God does not play dice", those drawn in the latter direction would want to emphasize the possibility of God acting in the world, for example in response to prayer.

Though "law" is the term used in the subtitle for this book, there are other related terms that could have been chosen, and some of these are represented in the titles of subsequent chapters. Things are further complicated by the fact that each of these terms can be used in a variety of different ways

Lawfulness is closely related to both determinism and necessity. Determinism has probably been more prominent in philosophy of science, whereas necessity has probably been more prominent in philosophical theology. We witness the familiar phenomenon here of theology and science using apparently similar concepts but ones that, on closer examination, prove to be significantly different. It is very important to distinguish here, as Clayton does, between what concept of the laws of nature is being employed, and whether or not a theological account of the laws of nature is being adopted.

Some of the complexities in the concept of lawfulness can be seen in different versions of natural theology. One can distinguish different traditions of natural theology that emphasize respectively the orderliness, the fruitfulness and the intelligibility of the natural world.[2] These are not interchangeable concepts, though it is arguable that all of them presuppose a certain basic lawfulness.

Orderliness is the closest to lawfulness, though the Hebrew Bible probably thinks about creation more in terms of order than of law. Even where there is an apparent reference to the lawfulness of the world, it would be anachronistic to read back into that the concept of law developed in certain dominant strands of Enlightenment thought. Certainly the Hebrew concept of law has no overtones of determinism.

Fruitfulness is a more significant concept from a religious point of view. The world could not have been fruitful without being orderly. It could have been orderly but barren, but it is hard to see what divine purpose would have been served by such a world. Fruitfulness is an important concept theologically precisely because it invites an inference about purpose behind creation, though purpose cannot be securely inferred from fruitfulness.

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2 N. A. Manson, ed., *God and Design* (London: Routledge, 2003).

The intelligibility of the world also presupposes lawfulness. It also raises issues about how realist we want to be about lawfulness. Is the lawfulness of nature there to be discovered, or is it a construction of the human mind? This is to pose the issue in rather extreme terms, but there are a variety of in-between positions. For example, it may well be that we are only likely to discover lawfulness in the natural world if we make prior assumptions about the lawfulness that we believe to be there.

Lawfulness probably needs to exist in some sense in both nature and the human mind before the two can be brought together. If so, it is not helpful to press the question of whether lawfulness is primarily a matter of nature or mind; both are in a sense primary. This is not to deny the reality of lawfulness in nature, and certainly not to suggest that lawfulness is merely a human projection, but it assumes that the discovery of lawfulness is an interactive process and depends both on what we humans bring to it, as well as on what is there to be found.

## Probability and Related Concepts

Terms like lawfulness, necessity and determinism each have an opposite, and there is a parallel set of distinctions to be made between such concepts as contingency, unpredictability, chance, randomness and probability. There are also important differences between this set of terms, though what they have in common is that they all imply some kind of openness. Space does not allow an exploration of all the issues that arise here, so I will restrict myself to making some brief remarks about chance, unpredictability and probability.

Chance is, in a sense, the most extreme term, and purely chance processes seem to be rare. Usually, chance intersects with other more predictable processes. A distinction needs to be made between concepts of chance that arise from human ignorance, and more metaphysical assumptions about chance. For example, it is widely assumed that there is indeterminacy in quantum measurement. However, that is not the universal view, and there is no evidence from which it necessarily follows. It may just be that we don't yet understand whatever deterministic processes are at work. Sometimes when we attribute outcomes to "chance", we are not saying much more than that we do not have any adequate way of predicting them. It is a big step from that to saying that an outcome is "due to chance", as though "chance" was some unusual kind of causation.

The concept of chance is at the heart of much scientific thinking about both mutations and multiverses. However, interestingly, there have been different theological reactions to the concept of chance in the two domains, and there may be an intellectual inconsistency here. I will assume for the sake of argument that which mutations occur is genuinely a matter of chance, even though the *rate* of mutation seems to be a response to changing circumstances, such as cosmic radiation. Theologically, it is tempting to argue, as Peacocke has, that chance mutations provide the scope for God's purposes to be fulfilled. Chance mutations, he argues, throw up a broad range of possibilities that can be scanned, as by a radar beam, selecting out what is fruitful for the divine purpose.

There are many versions of multiverse theory, discussed by George Ellis in Chapter Four. On one model there is a very large series of universes, which differ from one another randomly. Theologians have not been as sympathetic to the idea of chance multiverses, though it seems that an exactly parallel move could be made. One could postulate that random multiverses provide a broad range of possibilities from which God could select what was fruitful for his purposes. It is strange that the concept of chance has been more readily accepted by religious thinkers for mutations than for multiverses.

It may be because the idea of chance mutations seems so securely established scientifically that people feel that they have no choice but to accept it, whereas the idea of multiverses is a more speculative idea that people do not yet feel they need to accept. Or it may be because the idea of multiverses has been presented as an alternative to the anthropic principle, with a seemingly natural alliance between atheism and multiverses on the one hand, and between religion and the anthropic principle on the other. If chance really is compatible with religious thinking, that ought to apply in both contexts. However, as Bartholomew emphasizes, chance and probability are used in different ways in the context of different arguments.

Unpredictability has been the subject of sharp debate among the science and religion community. It is widely recognized, with the advent of chaos theory, discussed by Niels Gregersen in Chapter Five, that there are many complex systems that are unpredictable. The debate is about what can be inferred from that in terms of the openness of the universe. I think everyone agrees that unpredictability is different from indeterminism, and also that you can't legitimately infer indeterminism from unpredictability. Failures of predictability may occur in deterministic systems simply because there are too many variables to calculate.

There can be legitimate differences of view about whether unpredictability is suggestive of indeterminism. Though indeterminism can't be inferred from unpredictability, it is perhaps a reasonable metaphysical conjecture that systems that are unpredictable may in reality be under-determined, as John Polkinghorne has suggested.[3] The matter cannot be settled conclusively by the fact that the mathematics that is used to model chaotic systems is deterministic. It is possible that deterministic mathematics might provide a sufficiently good way of modelling a complex system that, in reality, had a degree of under-determination.

Turning to probability, one of the questions that will need to concern us here is whether probability is sufficient to infer divine purpose. To take a specific example, if the emergence of a species such as homo sapiens is probable in the course of evolution, is that sufficient to be consistent with the claim that it was God's purpose that such a species should evolve? Would God depend on something that was merely likely rather than something you could be sure would happen?

There is, of course, a sense in which theologians have often claimed that the world is contingent, meaning by that that God could have created it differently, that he didn't have to create it the way it is. However, that is not the kind of contingency associated with probabilistic laws. In the latter case, the point is rather that the way

3 J. Polkinghorne, *Belief in God in an Age of Science* (London: Yale University Press, 1998).

the universe is created often does not guarantee particular outcomes, it only makes them likely. My sense is that divine purpose, even after allowing for God having granted the world a degree of freedom, needs to depend on something stronger than likelihood. However, we are dealing here with one of those conundrums that seem an inescapable part of religious thinking.

## Reconciling Law and Probability

Whereas lawfulness, as we have come to know it, is a concept of early modernity, probability is a concept of late modernity. It was only when science moved beyond the assumption that the natural world was a mechanism that the concept of probability became relevant to science. In putting these concepts of law and probability alongside each other, we should be aware that we are bringing together concepts that have their roots in different eras.

It may initially seem that we are dealing with sets of opposite terms, that chance is the opposite of determinism, contingency the opposite of necessity, etc. However, it is important for us not to be too simplistic about this. Though it may appear that we are dealing with opposite concepts, they may not be mutually exclusive. Lawfulness and probability may be pointing in opposite directions, but they may not be incompatible with each other.

There is a conceptual interconnectedness between law and probability. It is at least arguable that probability and lawfulness are such interconnected concepts that one is parasitic on the other, and cannot really be defined without the other; just as, more generally, it is arguable that all words can only be defined in terms of their opposites. Rather than dealing with mutually incompatible concepts, then, we may be dealing with concepts that are necessarily interconnected.

There may well also be a fruitful intermingling of probability and lawfulness in terms of their consequences, as Arthur Peacocke pointed out in connection with evolution in *Creation and the World of Science*.[4] Neither pure unbroken regularity, nor the unpredictability of pure contingency are particularly fruitful. It is the combination of the two, the combination of lawfulness and contingency that is most fruitful. Though some have doubted whether chance can have a place in the divine purpose, David Bartholomew in Chapter Eight makes a strong argument that it can. For Peacocke and Bartholomew, it is the combination of chance and lawfulness that is particularly fruitful in fulfilling God's creative purposes.

The concept of probability is much closer to lawfulness than is either chance or unpredictability. It is a reasonable extension of the concept of the lawfulness of the natural world to include probabilistic laws as well as absolute ones. The key difference is perhaps that predictions from absolute laws are necessary, whereas predictions from probabilistic laws are contingent. Probability combines an element of predictability with an element of openness.

We should also note that the relationship between lawfulness and probability arises in different ways in the physical and biological/human sciences. These two

4 A. Peacocke, *Creation and the World of Science* (Oxford: Clarendon Press, 1979).

groups of sciences differ in so many ways that the science and religion dialogue is in fact completely different for these two different areas of science.

The physical sciences have stronger roots in early modernity and were initially dominated by a strong sense of lawfulness though, as many people have noted, they have moved towards having a view of the world as much more open than was the case with the physical science of early modernity. In the biological sciences, even where there are laws of some kind, they are statistical, probabilistic laws, not the kind of absolute laws for which the physical sciences have traditionally searched.

There are also issues here about different levels and about "emergence". Chaos theory has drawn our attention to the fact that there can be apparent order at one level and apparent disorder at another. In particular, order can emerge from disorder (or at least from extreme complexity) as in the case of the chemical clock; in other words, order can arise "at the edge of chaos".

It may also be that a degree of freedom can emerge at one level from determinism at a lower level. This issue of how to reconcile freedom and determinism is, of course, one of the classic philosophical problems. It arises, for example, in terms of how the processes of the brain, which are presumably largely deterministic, can give rise to freedom of thought and action. It is a problem that I believe is best tackled in dialogue with neuroscience rather than philosophy alone, and I am grateful for the way in which Nancey Murphy has approached it in Chapter Seven in terms of neurobiological reductionism.

A related scientific area that pinpoints this issue rather neatly is Artificial Intelligence. Could computers have freedom? Some would be inclined to see that as a preposterous idea, a gross exaggeration, and something that could only arise from redefining freedom almost out of existence. It is tempting to see an incompatibility between computers, (which are necessarily mechanical), and freedom (a distinctively human quality). One very interesting discussion of whether, and in what sense, computers could have freedom is to be found in *The Computer and the Mind* by Phil Johnson-Laird.[5]

Johnson-Laird's argument is based on the assumption that an operating system can generate a model of itself. Humans have reflective self-consciousness, probably the thing that most distinguishes them from other species. Computers can also, in principle, be programmed to have a comparable capacity to generate a reflective model of the operations that they are performing. For Johnson-Laird, that reflectiveness is what enables us to be free. We are free because we have models of ourselves that enable us to analyse the choices open to us. As he puts it, "our models of ourselves enable us to choose how to choose".[6] It is an argument that has enough prima facie plausibility to give us pause, though Gödel and others have taught us that self-reflexive systems can have surprising properties.

5 P. N. Johnson-Laird, *The Computer and the Mind: An Introduction to Cognitive Science* (London: Harvard University Press, 1988).

6 Ibid., p. 365.

**Theological and Secular Discourse**

There is a discussion to be had within philosophy of science about the role of lawfulness and probability in the natural world (philosophy of science would, of course, talk about "nature", not about "creation"). However, there is also a more specifically theological discussion to be had about creation, which is concerned with the role of lawfulness and probability in relation to divine purpose.

This book will be concerned with both discussions, and with the relationship between them. It is essential to ask, as Wildman does in Chapter Nine, how we may be able to move from scientific or philosophical discussions of law and chance to theological views about ultimacy. I want to urge the importance of being clear about the distinction between different discourses, and not sliding between philosophy of science and philosophical theology as though they were indistinguishable. Philosophy of science has important theological implications, and deserves careful consideration. However, there are also distinctively theological issues that need to be discussed.

It is also important to be aware that the theological issues are raised in different ways in different faith traditions. For various reasons, issues on the interface of theology and science have been explored more thoroughly in relation to Christianity than other faith traditions. However, other faith traditions enrich the dialogue, and John Bowker raises our awareness of this in Chapter Ten. For example, the concept of "creation" sits less comfortably with many world faith traditions than with Christianity,

**Agency and Non-agency Concepts**

I particularly want to emphasize the important difference between agency and non-agency concepts in this domain. Concepts like lawfulness, determinism and necessity (and their opposites) are non-agency terms. However, there is a related set of agency concepts, of which freedom and purpose are the most important. It seems to me that the philosophy of science proceeds largely at the level of non-agency concepts, whereas philosophical theology has a distinctive commitment to agency concepts, at least in the Abrahamic religions. Processes or mechanisms may be lawful, or probabilistic, but only agents are free; only agents have purposes. Religious thinking is more directly concerned with purpose and freedom than it is with law and probability.

The terms "law" and "probability" in the title of this book are non-agency terms. That implies a philosophy of science starting point. However, choosing the word "creation" rather than "nature" balances things in a theological direction. I believe that this book holds together a conversation about lawfulness and probability in nature, with a related theological conversation about purpose and freedom in creation.

The theological contribution to this discourse needs to work with a broad concept of creation that allows for what it is *becoming*, rather than just what *is*. In some traditions it would be helpful to introduce thinking about eschatology in addition to

that of creation. However, the concept of creation is potentially sufficiently broad, if it includes "continuing creation", to allow scope for discussion of what is becoming. Christianity has probably fallen prey, more than any other faith tradition, to the deistic heresy of thinking about creation solely in terms of what happened initially, though that is not faithful to the mainstream Christian tradition, and neglects the continuing nature of God's work of creation.

Here there is something of a tension between science and theology. Science is almost exclusively concerned with what is, not what is becoming, or what is purposed. Science runs scared of teleology; biology has both felt the attraction of teleology more strongly than physics, but also resisted it more strongly. Notions of direction, progress and purpose come up most acutely in evolution, as Michael Ruse discusses in Chapter Six. It is an intriguing fact about the relationship between science and religion that evolution is the area of science that has given rise to the strongest opposition to religion. However, partly because it is the area of science that is most open to the concept of purpose, it is also the most theologically congenial area of science.

Evolution also provides a nice example of the boundary between agency and non-agency thinking. There some evolutionary theorists, like Francisco Ayala,[7] who have introduced the concept of "directional change". Though it is not universally accepted, it seems to me unarguable that there is directional change in evolution, though there is scope for debate about how best to characterize the direction. For example, is it from simplicity to complexity, or towards increasing capacity for information processing, etc.? However, purpose goes beyond directional change, and you can perhaps only make the leap from directional change to purpose in evolution if you also make the leap from the non-agency thinking of philosophy of science to the agency thinking of philosophical theology.

There is a somewhat similar point to be made about the fine-tuned nature of the universe, about which there has been much discussion in cosmology. It seems an incontrovertible scientific fact that the universe is fine-tuned to be fruitful. However, it is not clear that you can go beyond that to reach conclusions about the purposes of the universe, (or even about what necessarily had to be the case in the universe) without making the leap to the agency thinking of theology. The fact that that leap is often made in the so-called anthropic principle is perhaps a reason for thinking that we are dealing there with secularized theology rather than with science per se.

While science struggles with the concept of purpose, purpose is central to theology. However, the religious concern with purpose can make use of assumptions about both lawfulness and probability. Wolfhart Pannenberg in his *Towards a Theology of Nature* addresses this issue in considering how to reconcile regularity and contingency,[8] and suggests that it is only on the basis of the assumption of a personal power behind the universe that it is possible to reconcile "the unity of occurrences

7 F. J. Ayala, "Can 'Progress' Be Defined as a Biological Concept?", in *Evolutionary Progress*, ed. M. Nitecki (London: University of Chicago Press, 1988).

8 W. Pannenberg, *Towards a Theology of Nature: Essays on Science and Faith*, ed. E. Peters (Louisville: Westminster/John Knox Press, 1993).

with the preservation of contingencies".[9] I am wary, here as elsewhere, of claims to the effect that only theology can solve our intellectual problems. However, I submit that there is a distinctive and attractive theological solution to the reconciliation of regularity and contingency, and it stems from the assumption of a personal agent.

Purpose and freedom are closely linked concepts for both human and divine agents. Purposes are freely chosen, and freedom is often a central purpose. From a religious point of view, one might want to say that the purpose of creation is freedom. God is assumed to be free and not subject to any kind of necessity, and it is perhaps part of the divine purpose that creation should ultimately participate in that freedom. God's freedom and purpose thus become intertwined. Theologically, creation has arisen from divine purpose, and was an act of divine freedom. Equally, freedom may be the destiny of creation, and the culmination of divine purpose.

It is one thing to think of human beings as in some sense free, and therefore already to some extent participating in the divine freedom. It is quite another to extend that to the non-human part of creation, though there are strong pointers in the faith traditions in that direction. The idea of extending the concept of freedom in creation beyond human beings would seem very strange to those who were not theologically motivated. However, it seems to me that there are good theological reasons for supposing that freedom is God's purpose for the whole of creation, not just for human beings. It is part of the impact of modernity on religious thinking that we have come to make a very sharp distinction between human beings and the rest of creation. However, creation, I suggest, is properly seen as much more than the stage on which the drama of the relationship between God and humanity is played out.[10]

If there is a major area of incompatibility between theology and science, it is perhaps locatable in the debates concerning whether creation (or nature) can be thought about in agency terms. Science seems to have a commitment to non-agency thinking, whereas theology thinks about "creation" rather than about "nature" and sees it in the agency terms of freedom and purpose. One might simply argue that theological thinking presupposes the non-agency thinking of science, but goes beyond it.

In this context it is perhaps finally worth raising the question of whether, in the long term, science has to restrict itself to non-agency thinking. Would science cease to be science if it ceased to impose that restriction on itself? Or is that restriction merely a convenience that has been adopted by science in its early centuries in order to carve out some tractable questions while it limbers up to explore larger and more difficult questions? At very least we need to be aware of the very different ways in which philosophy of science and religion approach law and probability, purpose and freedom, in what one calls "nature" and the other calls "creation".

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9 Ibid., p. 113.

10 N. L. A. Lash, "Production and Prospect: Reflections on Christian Hope and Original Sin", in *Evolution and Creation*, ed. E. McMullin (Notre Dame: University of Notre Dame Press, 1985).

**Outline of the Chapters**

The chapters of this book fall into three groups: philosophical (Chapters 1–3), scientific (Chapters 4–7), and theological (Chapters 8–11).

The first three chapters, this one and the next two, by Peter Harrison and Philip Clayton respectively, constitute a conceptual, historical and philosophical approach to the concept of the lawfulness of nature. We open up issues about how to integrate lawfulness with a degree of openness in nature, how the lawfulness of nature should be conceptualized, how that conceptualization has changed historically, and how it relates to theological assumptions.

Peter Harrison provides an account of the history of the idea of there being laws of nature, focusing predominantly on the seventeenth century when the modern concept first appeared. He also examines the subsequent development of the notion, including its appropriation by the life sciences. He emphasizes that, though the concept of laws of nature was initially based on theological assumptions, it has increasingly been maintained without such assumptions.

Philip Clayton seeks to establish a broad explanatory consonance between laws of nature and theism. He discusses various interpretations of the laws of nature, argues firstly for an interpretation of them as eternal necessities, and secondly that theism provides the most compelling explanation for such necessities. Clayton regards this broad explanatory consonance between theism and natural law as constituting a model for the dialogue between science and religion.

The next group of four chapters look at particular areas of scientific enquiry, and how concepts such as law and probability arise within them. The focus is often primarily on philosophical issues raised by current scientific developments, though the philosophical issues point towards theological implications.

First in this group of chapters, George Ellis looks at the concept of multiverses, one of the main areas of contemporary science in which the concept of randomness is currently receiving attention. Ellis considers the definition of multiverses, the theoretical motivation for hypothesizing them, and particular issues such as their uniqueness, lawfulness, randomness, etc. In particular he looks at broader philosophical and theological implications, such as whether there is a philosophically preferable version of the idea of multiverses, whether it precludes the assumption of a creator God, whether it implies multiple Gods, and the role of faith in relation to multiverses.

Next, Niels Gregersen examines different theological approaches to self-organizing systems. Using a three-strand typology consisting of the universal laws of nature, the general formative principles of nature, and the general rules of complexity, he argues that the interplay between these strands provides a fruitful basis for a theological account of a self-developing world. He distinguishes between using the notion of a benevolent creator to account for the unusual amenability of physical and chemical constants in the development and sustenance of life, and coordinating the general trends and contingent features of evolution with a theological framework.

Third, Michael Ruse considers concepts such as chance, direction and progress as they have arisen in evolutionary theorizing, He considers how far evolution can be considered a process of chance, or whether it can reasonably be construed

as reflecting progress and purpose. A key issue here is whether evolution can be explained in teleological terms. Ruse includes a discussion of the recent proposal by Simon Conway Morris that the phenomenon of evolutionary convergence suggests the inevitability of the evolution of intelligent life.

Finally Nancey Murphy considers determinism and freedom in relation to neuroscience, focusing especially on how downward causation may enable us to reconcile neural determinism with free will. She argues that the possibility of downward causation makes the determinism at lower levels compatible with free will. However, she acknowledges that, while this approach counters neurobiological reductionism, it does not necessarily amount to a full instantiation of free will.

The final group of chapters is more explicitly theological. David Bartholomew considers a number of arguments, arising from science, and involving concepts of probability, that have been used in theology. He focuses on six: the origins of life on earth; the probability of God's existence; the anthropic principle; intelligent design; divine action in the world; and whether chance may be regarded as part of God's providence. He stresses the rather different ways in which concepts of probability have been used in these arguments.

Next, Wesley Wildman considers how to move from philosophical notions of law and chance, as they arise within science, to more theological conclusions about the ultimate nature of reality. In particular, he explores the issue of how an ontology of nature constructed around ideas of law and chance resonates more with some metaphysical theories of ultimate reality than with others. He advocates a comparative metaphysics, capable of accommodating a variety of competing worldviews, as the only viable bridge between the natural sciences and metaphysical-theological theories of ultimate reality.

John Bowker then provides a much-needed a reminder of the range of world faith traditions and how they approach chance and necessity in very different ways. This includes a discussion of the relationship between lawfulness and the Indian doctrine of karma, how lawfulness is conceptualized in Islamic thought, and the different ways in which faith traditions make provision for openness in nature.

Finally, John Polkinghorne draws the threads together in a brief afterword in which he stresses that our discovery of deep regularities in the physical world, while patchy and by no means exhaustive, nevertheless uncovers a profound structure of intelligibility in the universe which points beyond a Humean explanation of such regularities in terms of mere constant conjunctions. He cautions against some of the more prodigious speculation in contemporary physics such as invocation of multiverses and insists on the need for further careful thinking about the promising concept of true "top-down" causality and the implications, for example, of complexity theory for theology. Finally he concludes that the beautiful principles of order in nature seem to call for explanation beyond that which science on its own can provide.

**Bibliography**

Ayala, F. J. "Can 'Progress' Be Defined as a Biological Concept?" In *Evolutionary Progress*, edited by M. Nitecki. London: University of Chicago Press, 1988.

Johnson-Laird, P. N. *The Computer and the Mind: An Introduction to Cognitive Science*. London: Harvard University Press, 1988.

Lash, N. L. A. "Production and Prospect: Reflections on Christian Hope and Original Sin." In *Evolution and Creation*, edited by E. McMullin. Notre Dame: University of Notre Dame Press, 1985.

Manson, N. A., ed. *God and Design*. London: Routledge, 2003.

Pannenberg, W. *Towards a Theology of Nature: Essays on Science and Faith*. Edited by E. Peters. Louisville: Westminster/John Knox Press, 1993.

Peacocke, A. *Creation and the World of Science*. Oxford: Clarendon Press, 1979.

Polkinghorne, J. *Belief in God in an Age of Science*. London: Yale University Press, 1998.

Saunders, N. *Divine Action and Modern Science*. Cambridge: Cambridge University Press, 2002.