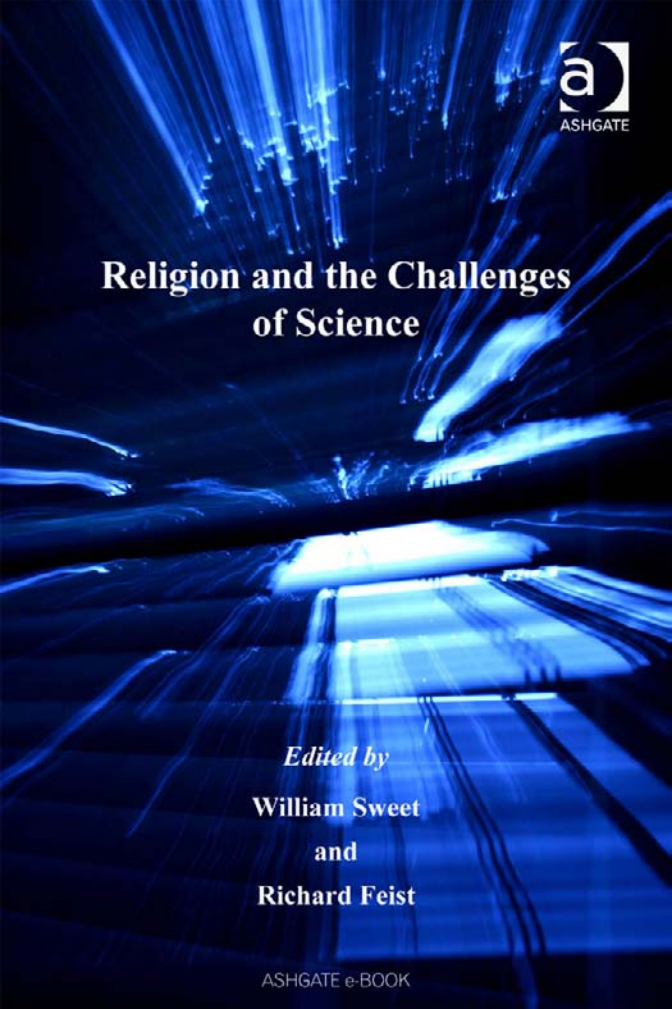
ASHGATE
Religion and the Challenges of Science
Edited by
William Sweet
and
Richard Feist
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RELIGION AND THE CHALLENGES OF SCIENCE

Does science pose a challenge to religion and religious belief? This question has been a matter of long-standing debate - and it continues to concern not only scholars in philosophy, theology, and the sciences, but also those involved in public educational policy. This volume provides background to the current 'science and religion' debate, yet focuses as well on themes where recent discussion of the relation between science and religion has been particularly concentrated.

The first theme deals with the history of the interrelation of science and religion. The second and third themes deal with the implications of recent work in cosmology, biology and so-called intelligent design for religion and religious belief. The fourth theme is concerned with 'conceptual issues' underlying, or implied, in the current debates, such as: Are scientific naturalism and religion compatible? Are science and religion bodies of knowledge or practices or both? Do religion and science offer conflicting truth claims?

By illuminating contemporary discussion in the science-religion debate and by outlining the options available in describing the relation between the two, this volume will be of interest to scholars and to members of the educated public alike.

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Religion and the Challenges of Science

Edited by
WILLIAM SWEET
St Francis Xavier University, Canada
and
RICHARD FEIST
Saint Paul University, Canada

ASHGATE

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Acknowledgements

The relation between science and religion has been a major topic of discussion in the last decades of the twentieth century, and this issue promises to remain so in years to come. Unfortunately the intensity of this discussion often seems to be inversely proportionate to the quality of the discourse. This volume aims at clarifying some of the underlying conceptual issues involved, providing an opportunity to discuss the particular contributions of philosophy, the physical and biological sciences, theology and religious studies, and history to this issue, and considering directions in which philosophical reflection on this issue might be fruitfully pursued.

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William Sweet and Richard Feist

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Contributors

William Sweet (Editor) is Vice-President (academic) and Professor of Philosophy at St Thomas University, Fredericton, New Brunswick, Canada. He is the author of *Idealism and Rights* (1997, 2005), *Religious Belief: The Contemporary Debate* (2003) and, with Hendrik Hart, *Responses to the Enlightenment: An Exchange on Foundations, Faith, and Community* (2007). He has edited several collections of scholarly essays, including *La philosophie de la religion à la fin du vingtième siècle* (1993), *God and Argument* (1999), *Idealism, Metaphysics and Community* (2001), *Philosophical Theory and the Universal Declaration of Human Rights* (2003), *Approaches to Metaphysics* (2004), *The Philosophy of History: a re-examination* (2004), and, most recently, *Bernard Bosanquet and the Legacy of British Idealism* (2007). He is a member of the Steering Committee of the Fédération Internationale des Sociétés de Philosophie, Vice President of the Istituto Internazionale Jacques Maritain (Rome), and President of the Canadian Philosophical Association.

Richard Feist (Editor) is Dean of the Faculty of Philosophy at Saint Paul University in Ottawa, Canada. He is the author of *Inference and Persuasion* (2005, with Leslie Armour), and has edited *Husserl and the Sciences: Selected Perspectives* (2004) and *Husserl and Stein* (2004, with William Sweet), and has published in *Études maritainiennes, Science et Esprit*, *Synthese*, *De Philosophia,* and other journals.

Paul Allen teaches in the Department of Theological Studies, Concordia University, Montreal, Canada; for several years he was also the Canadian Director of the Science and Religion Course Programme, sponsored by the Centre for Theology and the Natural Sciences (Berkeley). He is the author of *Via Media: Ernan McMullin and Critical Realism in the Science-Theology Dialogue* (2006) and has published in the *Heythrop Journal*, *Théologiques*, and the *Encyclopedia of Science and Religion*.

Leslie Armour is Research Professor at the Dominican College, Ottawa, and Professor Emeritus of Philosophy at the University of Ottawa. He is the author of '*Infini Rien': Pascal's Wager and the Human Paradox* (1993), *Being and Idea: Developments of Some Themes in Spinoza and Hegel* (1992), *The Idea of Canada and the Crisis of Community* (1981), *The Faces of Reason: an essay on philosophy and culture in English Canada, 1850–1950* (1981, with Elizabeth Trott), *The Conceptualization of the Inner Life* (1980, with Edward T. Bartlett), *Logic and Reality: an Investigation into the Idea of a Dialectical System* (1972), *The Concept of Truth* (1969), and *The Rational and the Real: an Essay in Metaphysics* (1962). He is a Fellow of the Royal Society of Canada.

John L. Bell is Professor of Philosophy at the University of Western Ontario. He is the author (with D. DeVidi and G. Solomon†) of *Logical Options: An Introduction to*

Classical and Alternative Logics (2001), *The Art of the Intelligible: An Elementary Survey of Mathematics in its Conceptual Development* (1999), *A Primer of Infinitesimal Analysis* (1998), *Toposes and Local Set Theories: An Introduction* (1988), *Boolean-Valued Models and Independence Proofs in Set Theory* (1977; 2nd ed., 1985), and (with M. Machover) *A Course in Mathematical Logic* (1977; 2nd printing, 1986). He has also published articles in *Transcendent Philosophy*, *Archive for Mathematical Logic*, *Husserl and the Sciences*, *History of Mathematical Logic*, *Axiomathes*, *Philosophia Mathematica*, *Journal of Philosophical Logic*, *Stanford Encylopedia of Philosophy*, *Journal of Symbolic Logic*, *Routledge Encyclopedia of Philosophy*, *Notre Dame Journal of Formal Logic*, *International Journal of Theoretical Physics*, *Synthese*, the *British Journal for the Philosophy of Science*, and *Philosophy of Science*.

Lawrence Dewan, O.P. is Professor of Philosophy at the Dominican College of Philosophy and Theology (Ottawa, Canada) and author of articles in *Acta Philosophica*, *Études maritainiennes*, *The New Scholasticism*, *Laval théologique et philosophique*, *American Catholic Philosophical Quarterly*, *Proceedings of the American Catholic Philosophical Association*, *Modern Schoolman*, *Dionysius*, *Dialogue* (Canada), and other journals.

Willem B. Drees holds the Chair of Philosophy of Religion and Ethics at the University of Leiden, the Netherlands. Drees is also President of ESSSAT, the European Society for the Study of Science and Theology. He has an advanced degree in theoretical physics, and doctorates in theology and philosophy. Drees has published and edited studies on religion and science, including *Beyond the Big Bang: Quantum Cosmologies and God* (Open Court, 1990), *Religion, Science and Naturalism* (Cambridge University Press, 1996), and *Creation: From Nothing until Now* (Routledge, 2001). He has won various prizes for his writings on religion and science, including the 'Legatum Stolpianum' offered once every five years by the University of Leiden, and a Prins Bernhard Fonds Prize for the humanities offered by the Hollandsche Maatschappij der Wetenschappen.

Lodovico Galleni is a lecturer at Università di Pisa, Dipartimento di chimica e biotecnologie agrarie, and in Centro Interdipartimentale per lo Studio dei Sistemi Complessi. His work includes research on the relation of theology and science, particularly in light of the work of Pierre Teilhard de Chardin. He has published in *Concilium*, *Aquins*, *Zygon*, *Journal of Theoretical Biology*, *Biology Forum*, and *Revue des questions scientifiques*.

Hannah Gay was, until her recent retirement, Professor of History at Simon Fraser University (Canada), and she is currently a Senior Research Investigator at the Centre for the History of Science, Technology and Medicine, Imperial College, London. She did her first graduate work in Chemistry at Imperial College, before moving to the study of the history and philosophy of science. Her recent work on science in Victorian London, and on issues of science and religion, has been published in a wide range of academic journals and anthologies.

Jerome (Yehuda) Gellman is a Professor of Philosophy at Ben Gurion University in Israel. His general areas of research include philosophy of religion, epistemology, and Jewish thought and he is currently working on projects which address topics of religious experience, the concept of belief, Hasidic thought, and feminist theology. His work includes: *Experience of God and the Rationality of Theistic Belief* (1997), *The Fear, The Trembling, and the Fire* (1994), *Mystical Experience of God: A Philosophical Inquiry* (2001), and *Abraham! Abraham! Kierkegaard and the Hasidim on the Binding of Isaac* (2003).

Kenneth Himma teaches Philosophy and Information Systems at the University of Washington, and holds adjunct appointments in the Comparative Religion Department and in the School of Law. He is an associate editor of the recently released *Oxford Handbook of Jurisprudence and Philosophy of Law* and has published in the *International Journal for Philosophy of Religion*; *Faith and Philosophy*, *Southern Journal of Philosophy*, *History of Philosophy Quarterly*, *Oxford Journal of Legal Studies*, and *Legal Theory*.

Job Kozhamthadam, S.J., is Professor in Philosophy of Science, Science and Religion and Basic Science at Jnana Deepa Vidyapeeth, Pune, India. He has frequently been Visiting Professor of Philosophy of Science at Loyola University of Chicago. He holds degrees in Physics from St Xavier's College (Ranchi) and from Patna University, and in Philosophy and in Theology from Jnana Deepa Vidyapeeth (Pune), Vidya Jyoti (Delhi), The University of Notre Dame, and The University of Maryland. He is the author of *The Discovery of Kepler's Laws: The Interaction of Science, Philosophy, and Religion* (named an Outstanding Academic Book of the Year 1994 by *Choice* Magazine), and Editor of *Interactions and Interpretation: Philosophical Reflections on Science, Religion, and Hermeneutics* (1997) and *Contemporary Science and Religion in Dialogue: Challenges and Opportunities* (2002). He is a Member of the Indian National Commission for the History of Science, Indian National Science Academy.

Denis O. Lamoureux is an Assistant Professor of Science and Religion at St Joseph's College in the University of Alberta. He is a co-author (with Phillip Johnson) of *Darwinism Defeated?: The Johnson-Lamoureux Debate on Biological Origin*s (1999), and has published in the *Journal for Interdisciplinary Studies* and the *Canadian Catholic Review*.

Arthur Peacocke is a priest in the Church of England and the founder-Director of the Ian Ramsey Centre at St Cross College, Oxford. Peacocke earned a D.Phil. in physical biochemistry in 1948, and taught the subject at the University of Birmingham (1948–59) and St Peter's College, Oxford (1959–73). He later served as Dean of Clare College, Cambridge. The author of some 126 papers and 3 books in the area of biochemistry, he is also the author of 63 articles/papers and 9 books in the areas of theology and philosophy. Among his books are *Creation and the World of Science* (1979), *Intimations of Reality; critical realism in science and religion* (1984), *God and the New Biology* (1986), *Theology for a Scientific Age* (1990; 1993), *From DNA*

to Dean – reflections and explorations of a Priest-scientist (1996), and *God and Science: quest for Christian credibility* (1996), *Paths from Science towards God: the End of All Our Exploring* (2001). He won the International Lecomte du Nouiy Prize in 1973, is a member of the Order of the British Empire (1993), has been awarded the senior degree of D.Sc. as well as a D.D. by Oxford, and has received honorary doctorates from Georgetown University and De Pauw University. He was the recipient, in 2001, of the Templeton Prize in Science and Religion.

Marie-Claire Groessens-Van Dyck is a paleontologist, a Professor in the Unité de géologie and the Unité de paléontologie et de paléographie, and a member of the Centre de Recherche en Histoire des Sciences, at the Université Catholique de Louvain in Louvain-la-Neuve, Belgium.

Introduction

Rethinking Relations between Science and Religion

William Sweet

Introduction

The scholarly discussion of the relations between science and religion, and particularly of whether religion and science conflict, is of long standing.[1] But it may not be obvious how wide-ranging and complex that discussion has been.

Initially, debate in the West took place within the religious (or the religious–political) sphere. To be precise, the issue was not the relation of religion and science as such, but rather that of the theories and experiments of individual scientists – to see how far these theories and discoveries were compatible with religious teachings or acceptable to religious and political authorities. To take one famous example, it was only once the conclusions of the heliocentric theory developed by Copernicus and Galileo were taken to challenge putative religious beliefs (and thereby entered into the religious sphere) that we can speak of a conflict between astronomical science and religion. During the last century, however, examination of the issues was somewhat broader, and discussions increasingly took place in the 'public sphere', where religion and science competed for the support of that public. Debates between, for example, those defending evolutionary theories and those appealing to creationist or direct divine design accounts were not so much within religion as within public education or within the law. Most recently, however, the locus of the discussion of these issues has shifted yet again, and it is scientific discourse – together with 'popular' scientists (such as Richard Dawkins and Stephen Jay Gould), scientifically informed philosophers (for example, Daniel Dennett), and religious believers who come to the debate with a strong scientific training (for example, John Polkinghorne and Arthur Peacocke) – that seem to set the parameters.

Clearly, then, the ways in which the issue of the putative conflict of science and religion has been engaged, the assessments of where the burden of proof lay, and intuitions of how a satisfactory resolution of the debate might be achieved, have changed significantly. It is not so clear, however, how far progress in discussion has been made. For example, the underlying assumptions that frame both the classical and contemporary debates need to be taken into account, but the understandings throughout these exchanges of what 'science' is, and what 'religion' is, are frequently either vague or altogether absent. In light of this, some might well wonder whether much fruitful discussion has even occurred.

This volume aims at surveying and discussing some of the principal ways in which science has been said to challenge religion – recognizing that religion and science have also been regarded as being in other relations to one another (for example, as

not being in conflict, but being fundamentally compatible) and also as being neither in conflict nor compatible (for example, as being of different logical orders). This volume also seeks to explore and explain ways in which religion and science have been understood. These two aims require a consideration of the historical background as well as looking specifically at areas in which the contemporary discussion is to be found – in cosmology and in the biological sciences. But they also require a clarification of some of the underlying assumptions and conceptual issues involved. Though the authors of the essays in this volume approach the central issue from different perspectives, through their work we can better see what kinds of relations between religion and science have in fact existed, what other relations might be possible, and how future discussion of this topic might be productively pursued.

Relations

Today – though, of course, not just today – religion and science are often regarded as being in conflict. And when we hear of conflicts between religion and science, we find that they can occur (broadly speaking) in two ways – that science opposes religion, and that religion opposes science.

As an illustration of the former, consider the view that the world was created between six and ten thousand years ago – which, despite claims by some that it is a scientific hypothesis, has standardly been taken as a religious belief. Largely as a result of the science of archaeology and the technology involved in it (such as the development of tools used in locating and excavating fossil remains, and in carbon dating), this belief has been challenged and widely abandoned. One might conclude, then, that in this and in similar cases, science has enabled human beings to demonstrate the falsity of certain religious beliefs, and that it is only a matter of time before other – perhaps all other – religious beliefs suffer the same fate.

Now, there are many ways in which religion has been considered to be conflict with science – not merely as offering an opposed hypothesis for the explanation of what is, but as calling for restrictions on scientific research or activity. An example of this is the implicit appeal to religious belief or religious ethics that some have made in calling for limits on certain scientific projects and medical procedures. In the area of genetics, for example, representatives or adherents of a number of religious traditions have sought to regulate scientific or medical procedures – and, more broadly, to restrict research – on such projects as the stem cell and the human genome. In cases such as these, religion is regarded as attempting to provide or impose restrictions on how science is to be engaged and pursued, and thus constrain the autonomous activity of the scientific project itself.

Some hold, however, that in spite of such problems, the relation between religion and science has generally been a positive one. They point to the ways in which religion has contributed to science, and they note, as well, the number of religious believers throughout history who have engaged in scientific research.

Many scholars would insist, for example, that religions – and western religions in particular – have contributed to the manner and method according to which, in the past 500 years, science has been pursued. Religion, they say, lies at the historical

origin of the modern scientific project, and modern science began in a culture that was imbued with religious ideals. Roger Bacon, Copernicus, Gregor Mendel – but also Newton and even Darwin – were led to scientific study by their pre-existing religious commitments and the wish to understand something more of the creation around them. Alfred North Whitehead, in his Lowell Lectures at Harvard University (later published as *Science and the Modern World*[2]), maintained that 'the Christian religion is the mother of science'[3] – that because 'of the medieval insistence on the rationality of God,' the founders of western science had an 'inexpungable belief that every detailed occurrence can be correlated with its antecedents in a perfectly definite manner, exemplifying general principles. Without this belief the incredible labors of scientists would be without hope.'[4] Because of their conviction that God is rational, many scientists in the modern era have held that the world – God's creation – is rational and ordered and, therefore, open and accessible to rational, law-seeking, investigation.

One might also say that there is a compatibility of science and religion in an indirect way – that science contributes to maturity in belief. For example, the results of scientific research may suggest to believers that religious beliefs cannot be simply straightforward descriptions or empirical explanations of events, and so remind them that, as adults, they cannot be and ought not to be satisfied with the level of religious understanding that they had as children. Thus, the development of evolutionary theories raised the issue of how believers should understand not only scriptural accounts, but the actual process(es) by which the world can be said to be a product of the divine. This, in turn, led to a refinement and a clarification of both the religious view of creation and the specific content of the scientific claims that initially seemed to challenge it.

Yet there are, as well, those who say that there is neither a genuine conflict nor a real compatibility between science and religion. While this claim can be – and has long been – developed in many ways, in recent years it has been presented in the form of what Stephen Jay Gould and Anthony O'Hear have called 'non-overlapping magisteria'. This option is suggested by the remark (sometimes attributed to Galileo) that 'The Bible tells us how to go to heaven, but not how the heavens go.' Thus, in his 1995 book, *Rocks of Ages: Science and Religion in the Fullness of Life*[5], Gould held that the reason for much of the alleged conflict between science and religion is that one or the other – or both – sometime overreach or overstep their respective boundaries. Science has, as its proper sphere, the realm of *fact* – that is, the nature of the material world and how certain states of affairs came to be (that is, what caused them). Religion, on the other hand, has as its proper sphere, what might be called the realm of *meaning* – that is, giving the inner significance of something – and seeks to show that there are important ideals or values that lie deep within and pervade all things.[6] Religion and science, this view holds, *need* not conflict, but they consistently *do* whenever one or the other takes itself as being a (or the) comprehensive explanation of what there is and why there is what there is – or, to put it simply, when one or the other oversteps its proper limits.

The roots of this view can be traced back to Pascal, if not Augustine[7], and it is very close to the kind of fideism that has been found in theologians, such as Karl Barth, and in contemporary philosophers such as D.Z. Phillips and Peter Winch.[8]

Moreover, we see a similar approach in discussions of the relation of art or morality to science. Art and morality have long been considered to constitute spheres of activity entirely separate and distinct from science as science, and so it is not surprising that some see the same situation to apply to religion as well.

From the illustrations above, it is clear that arguments can be made for seeing the relations between religion and science in very different ways. And so one may be led to wonder whether it is possible to make *any* general statement concerning the relations between science and religion or concerning whether or how science poses challenges to religious belief. Is there any way to prefer one of the preceding accounts to the others?

Challenges and Responses

To see how – or, at least, whether – science challenges religion, it is useful to look at those areas in which the conflict is said to be at its greatest today; these areas are biology and evolutionary theory; cosmology, complexity, and 'fine-tuning'; and philosophical naturalism. The authors in this volume provide both a context for these current debates and discuss some of their central themes.

In the contemporary discussion of the relations of science and religion, much attention has focussed on the issue of evolution. Part I ('History and Contexts in Biology and Evolutionary Theory') reviews some of the background to modern evolutionary theory, as well as a few of the responses to it from both broadly religious and philosophical perspectives. Here, the issue is primarily that of explaining the origin and characteristics of human beings (though it also bears on all biological being and, ultimately, all life); the central question is, 'How can we explain the complex, information-rich structures of biology?' Religious believers usually answer that an intelligent creator, designer, and cause is necessary; others hold that there is simply no room for an appeal to the non-natural or the divine – that the existence of God or the gods 'is utterly extraneous to evolution as Darwin and his modern successors have understood it'.[9] On this latter view, religious beliefs have no explanatory value, and evolutionary theory is so widely accepted that, in 1989, the current Oxford Professor for the Public Understanding of Science, Richard Dawkins, wrote in *The New York Times*: 'It is absolutely safe to say that if you meet somebody who claims not to believe in evolution, that person is ignorant, stupid or insane (or wicked, but I'd rather not consider that).'[10] (When the charge of arrogance and intolerance was raised against him, Dawkins recently replied: 'Examine the statement carefully and it turns out to be moderate, almost self-evidently true.'[11]) Similarly, in a popular book by Daniel Dennett, *Darwin's Dangerous Idea*, the author calls Darwin's theory of evolution by natural selection 'the single best idea anybody ever had'[12] – adding that Darwinism is a 'universal acid' that eats through virtually all traditional beliefs, especially Christianity. The challenge of science here, then, is that evolutionary theory contradicts – or at least is generally incompatible with – religious faith.

Does evolutionary theory count against religion or religious belief in the way in which Dennett, Dawkins, and others suggest?

In '"The Declaration of Students of the Natural and Physical Sciences", revisited: Youth, Science, and Religion, in mid-Victorian Britain', Hannah Gay describes a debate which took place in the years following the publication of Darwin's *Origin of Species*. What is particularly interesting about this debate was that it was within neither the scientific community nor the established church as such, but within the public sphere. In the 1860s, a group of young men associated with The Royal College of Chemistry (and favourable to the new ideas in biology, geology and the other natural sciences), were concerned about some of the putative consequences of these ideas for religious belief. 'The Declaration of Students of the Natural and Physical Sciences' – signed by some 717 individuals, including a number of leading scientists – stated that 'if [a scientist] finds that some of his results appear to be in contradiction to the written word [of Scripture], or rather to his own interpretation of it, which may be erroneous, he should not presumptuously affirm that his own conclusions must be right, and the statements of Scripture wrong.'[13] Gay notes that there were many scientists who were sympathetic to the content of the Declaration, but who refused to sign because they feared it might be harmful to the cause of science. Gay also reminds us that many did not see any particular conflict between science and religion – and that some even allowed that science may not always have the right answer when its conclusions appear to conflict with religious belief.

Some scholars have pointed out that, if we examine carefully what is generally held to be the source text of evolutionary theory, Darwin's *The Origin of Species* (1859), we will find no allegation of a conflict between science and religion. In 'Theological Insights from Charles Darwin', Denis Lamoureux argues that Darwin not only made a number of references to design in nature in his *Autobiography* and in his early notebooks,[14] but thought 'theologically' throughout his scientific career. In addition to the theme of intelligent design, Darwin discussed the problem of pain and the question of divine sovereignty over the world. Thus, a Darwinian could hold that there is intelligent design in nature without abandoning evolutionary theory. Not only that, Lamoureux maintains that 'theological insights from Charles Darwin are valuable in the development of an evolutionary theology'.[15] Even in the one of the reputed fathers of contemporary religious scepticism, evolutionary theory and religious belief may not be as opposed as many people have been led to believe.

One significant response to evolutionary theory – and to the claim that there is a conflict between evolutionary theory and religion – was given in the early twentieth century by Pierre Teilhard de Chardin. A palaeontologist as well as a Jesuit priest, Teilhard approached the issue from a scientific perspective, situating his research within a wide vision of evolution that some have claimed anticipates the current debate in biology on complexity. In 'A Model of Interaction between Science and Theology based on the Scientific Papers of Pierre Teilhard de Chardin', Lodovico Galleni and Marie-Claire Groessens-Van Dyck describe the background to Teilhard's attempt to bring together theories on the evolution of life and Christian theology. On Teilhard's view, evolution is a peculiar way in which creation occurred – a way which has to be taken seriously by theology. But evolution is not a movement without direction; it is a movement towards complexity and the existence of 'the Noosphere'. Biblical notions, such as covenant, salvation, and redemption, are to be placed inside the general evolutionary process. Teilhard also held that science and scripture together

tell human beings why and how to build the earth to reach the final evolutionary stage – what he called the Omega point, characterized by the second coming of Christ. Science – and evolutionary theory in particular – are, therefore, compatible with and can be accommodated within a broad metaphysical or theological view.

A more recent response to accounts of evolution can be found in the work of those such as Arthur Peacocke – a biochemist, theologian, and Anglican priest, and winner of the 2001 Templeton Prize for Progress in Religion. In the essay here on 'Biology and a Theology of Evolution', Peacocke argues that not only is there no fundamental conflict between evolutionary theory and religion, but the discoveries of science provide a stimulus to theology. Specifically, Peacocke holds that science provides a basis for a more encompassing and enriched understanding of the interrelations of God, humanity, and nature – one that requires believers to focus on God's immanence. Admittedly, this view challenges classical theism and its notion of God as separate from and independent of the world, in favour of a panentheistic view of God as an immanent Creator, creating in and through the processes of the natural order. Yet this, Peacocke holds, also leads to a more robust notion of a Sacramental Universe – and to the view that evolution is 'consummated in the Incarnation in a human person of the cosmic self-expression of God, God's Word'.[16] Thus, not only does evolutionary science not conflict with religion, but it contributes to a more profound theological reflection.

The essays in Part I, therefore, maintain that one need not opt either for the incommensurability of science and religion or for the claim that science and religion directly conflict. Compatibility remains an option – though it may be an 'open-ended' compatibility, where the nature of religion and the nature of science are both open to revision and reinterpretation.

A second point where the relation between religion and science has frequently been discussed is in cosmology, and involves the results of mathematical physics. In Part II ('Physics, Philosophy, and Fine-Tuning'), the authors focus on what conclusions might be drawn from the apparent order, complexity, and regularity in the universe.

Does such regularity and order need to be explained? Some have said that order is simply inherent in physical phenomena, or that the term is employed by scientists merely as a heuristic device in describing certain features of the physical universe. Others have replied, however, that the 'Big Bang' theory of the origin of the universe – that the universe sprang into existence from nothing and then expanded, continually cooling and attenuating, into its present state – gives us evidence for an *ex nihilo* creation and points to the need for a 'starting principle' (which some have called 'God').[17] Edmund Whittaker (1873–1956), famous for his work in celestial mechanics and the history of applied mathematics and physics, wrote that 'There is no ground for supposing that matter and energy existed before and was suddenly galvanized into action. ... It is simpler to postulate creation ex nihilo – Divine will constituting Nature from nothingness.'[18] From a somewhat different perspective, Alfred North Whitehead – together with those of his disciples who have developed what is today referred to as 'process philosophy' and 'process theology' – have held that there needs to be some 'first principle', and that contemporary science (such as relativity theory) is compatible with basic religious beliefs such as the existence

of God. 'Process' theorists find that, at least on this point, science and religion do not conflict.

Are there good arguments for the existence of a 'starting principle' of the cosmos, and do they establish the harmony – if not the mutual support – of science and religion? In 'Creation, Metaphysics, and Cosmology',' Lawrence Dewan argues that 'creation' is a doctrine of religion based on revelation, not a conclusion of science, and that we should not therefore be overly optimistic about the 'Big Bang' theory supporting the religious doctrine of a creation in time. Dewan holds that looking to science for proof of creation leads not only to a bad physics, but to a bad metaphysics and to a problematic view of religion. He notes as well that critics have pointed out that understanding 'Big Bang cosmology' in terms of 'creation *ex nihilo*' is not a strict conclusion of physics, but is a result of living in a culture heavily formed by religious doctrine. Nevertheless, Dewan allows that, even if the Big Bang hypothesis cannot provide evidence for *creation* – particularly for creation *ex nihilo* – science does provide important information concerning the age of the universe and what such a beginning could look like. To this extent, then, the probabilities of science can be consistent with the certainties of metaphysics and religion, and there is compatibility between science and religion.

In 'Cosmological Theories and the Question of the Existence of a Creator', John Bell notes that some scientific cosmologists have rejected the question of the origin of the universe altogether. Instead, they prefer a theory of the universe which denies that there ever was a time when the universe did not exist. Bell remarks, however, that this response leaves much unexplained. For example, some have argued that there are properties of the universe that show that it has been 'finely-tuned' – that many things need to be *exactly* as they are for life to exist – and that it is simply improbable that the universe is the result of chance. To reply that the 'fine-tuning' of the fundamental constants of nature was a brute fact would be, Bell points out, tantamount to an acknowledgment that the laws of physics were themselves brute facts. *Their* contingency, however, would make it plausible for the theist to suggest that these *laws* had been expressly selected from the spectrum of possibilities by divine choice. The only way to avoid this result would be to argue for a 'metaphysical pluralism' – that is, to hold that there are realms of being which are the products of, and are governed by, entirely different physical laws. But, a perspicacious reader might conclude, in the absence of any solid argument for such an alternative, there is at least some support for the existence of a designer and, thereby, a compatibility with religion.

Another way in which the conclusions of cosmology and mathematical physics might be understood in relation to religion is found in Whitehead. This approach is not, however, scientific or religious, but philosophical. In 'Whitehead, God, and Relativity', Richard Feist summarizes Whitehead's attempt to construct a speculative philosophy that seeks to '… frame a coherent, logical, necessary system of general ideas in terms of which every element of our experience can be interpreted'.[19] If such a speculative philosophy can be developed, and since science refers to things that are among the elements of experience, then religion, science, and the relation between them will fall under speculative philosophy's mandate. Feist considers Whitehead's response to Einstein's relativity theory, where Whitehead attempts to construct a

speculative philosophy that includes both God and the basic space–time framework of relativity – a project that has been continued by process theology. Feist argues that if we allow that there are two types of time in the metaphysics of Whitehead – one belonging to physics, where the investigations of science take place ('physical time'), and another, 'metaphysical' sense (which would be the temporal perspective of God) – a speculative philosophy that brings science and religion together may indeed be possible.

A different approach that suggests a relation between the physical sciences and religion again draws its impetus from the 'fine-tuning' argument. In 'Design Inferences, Fine-Tuning, and the Prior Probability of Divine Intelligent Agency: What the Fine-Tuning Argument Shows', Kenneth Himma considers whether the existence of 'fine-tuned properties' provides epistemic grounds for preferring theism to atheism. Himma argues that we cannot, in fact, speak of the probability or non-improbability of the occurrence of 'fine-tuning' because we cannot express 'probability' here in a philosophically and mathematically rigorous way. He concludes, then, that even if we accept that some properties are 'fine-tuned', there are no *strong* grounds for preferring theism to atheism – although a comparison of the relative probabilities of the truth of theistic and atheistic 'solutions' may suggest that it is not unreasonable to hold a theistic hypothesis.

What can we conclude from these discussions of cosmology and of design or 'fine-tuning'? As with much of the current debate in cosmology, the question of the relation between religion and science remains unresolved. The results of cosmology do not obviously provide a basis for arguing for religious belief, but neither do they show that there is a conflict between religion and science or a radical distinction or incommensurability of the two. It is, therefore, not implausible to hold that there is a compatibility – if only an 'open-ended' compatibility – of science and religion. But it is important to recognize that such a conclusion presupposes that what counts as science and what counts as religion are clearly understood and have been carefully defined.

Present throughout the preceding discussions is the assumption that the relation between religion and science is something that can be determined simply by the quality of arguments for which the standards of proof are clear. Yet this assumption itself presupposes that what is to count as evidence is not in dispute: that such evidence has to be empirical, and that naturalistic explanations are prima facie more plausible than non-naturalistic ones. Further, it also seems to be assumed that if whatever needs to be explained – including what has been long held to be *distinctively* religious – has a naturalistic explanation, then there is little room for reasonable religious belief, and even some justification for holding a positive incompatibility between science and religion. In Part III, 'Naturalism and the Non-Natural', then, the authors raise and respond to some of the challenges that naturalism as such poses for religious belief.

As an illustration of these challenges, Jerome Gellman ('On Scientific Explanations of God-Experiences') examines the phenomenon of reports of experience of contact with the divine. In recent years, the 'argument from perception' (which draws an analogy between experiences of God and sense-perception[20]) and the 'doxastic practice approach' of William Alston[21] have been used to defend the view that religious experience can properly serve as evidence for the existence of the

object of that experience. But are such experiences veridical? While some scientists have claimed that, as far as neuroscience is concerned, 'it can neither be proved or ruled out on empirical grounds' that God (for example) really does appear to people, Gellman maintains that – in principle, at least – neuroscientific findings could make it quite unreasonable to believe that God-experiences were veridical. Thus, so far as science can provide a naturalistic explanation of alleged God-experiences, it challenges the claim that the object of these experiences exists and, by extension, the truth of theism.

The possibility of such a confrontation presupposes, of course, that there is commensurability between empirical science and religious experience. It is because they are on a par that the results of science can count against religion. But it would also seem to follow that the results of science could count *for* religion and, further, that religion could count *against* science. It also seems to presuppose that a naturalistic explanation is not only a sufficient, but a more probable, explanation than a religious, non-natural one.

Another illustration of the challenge of naturalism arises in contemporary research in biology. In 'The Human Genome Revolution, Society, and Religion', Job Kozhamthadam provides some of the background and history to the 'Human Genome Project', established in 1990 by the US Department of Energy and the National Institutes of Health, and completed in 2003. He also discusses some of the philosophical, moral, religious, and scientific implications of the Project. Kozhamthadam notes that developments in science affect not only what science does, but our understanding of what science is. Thus, the many advances in the natural and applied sciences in the last century have gradually changed our understanding of the nature of science in significant ways; science as 'the activity of the genius in isolation' has now become 'the activity of a community'. The Human Genome Project has, moreover, provided further support for arguments for the unity in diversity of the living world, for the unity of scientific enquiry, and for evolutionary theory. Nevertheless, Kozhamthadam points out that while the results of the Project may be used by some as a means of justifying discriminatory policies, these results also show the limits of a naturalistic reductionism. He insists that despite the strength of a naturalistic approach to science, this is still not sufficient to establish a naturalistic view overall. Contemporary biological research, then, is not only consistent with religion, but may even provide positive support for religious belief.

That there is a close relation between religion and the natural is indeed plausible; traditionally, many religious traditions have had room for 'natural theology', and several have what we may call a theology of nature. But modern science is, without a doubt, naturalistic in a strong sense. And, as noted earlier, the results of science certainly appear to have had an impact on religion and religious belief.

Where does this leave us with regard to naturalism? In 'Partner of the Sciences or Object of Study? Theology and Religion in Relation to the Sciences', Willem Drees considers the place of naturalism in the discussion of 'religion-and-science'. Drees argues that efforts to establish a 'consonance' or 'harmony' between religion and science, or to treat religious views as comparable to scientific explanations, fall short on both epistemic and moral grounds. Nevertheless, Drees allows that we may still engage in a research programme in 'religion-and-science' that is naturalistic

(acknowledging that human existence, including human cultures, moralities and religions, are the fruit of, or even part of, nature) while, at the same time, holding 'anti-naturalist' attitudes (acknowledging that humans are able to go beyond and against that which has been handed down by nature to them). Thus, 'creation' is not to be understood simply as the production of an effect by an efficient cause, but as an event that also brings with it a sense of 'redemption' – which Drees argues is theologically more adequate. The statement that there is a relation between science and religion, Drees concludes, is not so much a descriptive claim as a 'constructive project'. Science and religion should not be seen as offering competing explanations or hypotheses, but as creating a tension *within a theology*, whereby religion is 'explored in relation to successes and limitations of a naturalistic understanding of the world'.[22] Naturalism need not lead to refuting, and it may lead to rethinking, religious belief.

A second response to the challenge of naturalism has been to distinguish between methodological naturalism and ontological naturalism. In 'Beyond Naturalism: Scientific Creativity and Theological Knowledge', Paul Allen discusses the claim that philosophers and theologians should embrace naturalism because science has succeeded in providing an explanatory framework for natural reality and because evidence supports the conclusion that there is only one order of existence – the natural. Allen notes that moving to such an ontological or 'religious' naturalism would be fatal to theological claims concerning divine creation, providence, and salvation. In any event, Allen argues, such a move is unnecessary. Contemporary theology focuses on more exclusive existential, historical or ethical issues that do not involve metaphysical or epistemological challenges with science. We can, then, allow naturalism where it is *methodologically* appropriate – for example, in the sciences – without being logically required to allow it where it would be inappropriate – for example, in religion.

It is possible, therefore, to employ a naturalist approach in science, and yet not be committed to an ontological naturalism that would, arguably, entail conflict between science and religion. Indeed, despite the naturalistic character of science, it is still plausible to claim that there is compatibility between religion and science. One can conclude, then, that whatever differences there may be between the two, there is neither a general conflict between nor an incommensurability of science and religion.

The challenges of science to religion are not based just on 'matters of fact' and empirical data; as we have seen, they involve methodological and metaphysical assumptions as well. It is for this reason that it is rather difficult to say what the relations are between science and religion. There are, arguably, other issues to be considered. For, in raising the question of the relations between science and religion, we also have to ask how the terms 'science' and 'religion' are to be understood, whether they have been consistently understood in these ways in the past, and whether those participating in the debates are themselves agreed on what they mean. What, then, is science? And what is religion? Several responses to these questions have been proposed, and, in Part IV ('Conceptual Issues'), the authors explore two recent possibilities.

What is it to do science? In 'Can Science Provide Evidence for Metaphysics?', Leslie Armour notes that both the natural and the social sciences acknowledge that reality needs interpretation – that there is no neutral account of reality, and that our studies of it always refer to a larger theory. As Armour puts it, the world is 'not simply a bunch of hard stuff out there', but 'a book to be read' – and there is an indefinitely large number of 'readers'. Armour does not mean that there is no objective reality and that all is a matter of interpretation. 'The world' is that which must be interpreted and, so far as we recognize that *something* is being interpreted, there is an objective reality. But this approach also means that there is more to the real than just 'the material'. Intelligence is characteristic of 'the world' and, because there are a potentially infinite number of persons, there are a potentially infinite number of readings; in this sense we can speak of a pluralistic world. Moreover, one can speak of an intelligence in the universe that goes beyond human subjectivity (though it is expressed through us). Armour argues that contemporary physics and cosmology provide evidence for such a view – that reality is 'a set of symbols that can be interpreted in a way that makes some interpretations better than others, but that they do not yield a univocal reading'.[23] Science and religion, then, are readings. For Armour, however, religion is *not* just another reading, but is – as it were – the conclusion of the search for a complete reading.

How are we to understand the concept of religion? In 'Science and Religious Belief: Some Conceptual Issues', William Sweet uses the example of the 'Evolution versus Intelligent Design (ID)' debate to see what the alleged conflict between science and religion assumes about the nature of both. Sweet argues that both sides in the ID debate in fact share certain presuppositions about the character of religious and scientific claims – and that it is because of this that both find a conflict between ID theory and evolutionary theory. But Sweet argues that these presuppositions are mistaken. Religious beliefs have a distinctive character that sets them apart from the hypotheses of science. Religious beliefs and the results of science bear on one another, but if we fail to understand the differences between them, we cannot make any progress on understanding their relation either.

The essays in Part IV tend to the view that, if we understand religion and science in ways that reflect how they are engaged in or practised, there is no fundamental conflict between them. Yet neither is there a straightforward compatibility, such that the results of science or scientific investigation prove religious belief. Science can establish or challenge empirical claims, and these may in turn confirm or raise doubts concerning corresponding metaphysical or religious beliefs. This does not mean, however, that science refutes or demonstrates these beliefs. It may simply entail that, as our knowledge progresses, we will be called to reread, review, and rearticulate the specific content of both our religious and our scientific views. And in rethinking these views, the questions and concerns which motivate them must also be considered before one can expect any results concerning the relations between religion and science.

Directions

What can we conclude about the contemporary discussion of science and religion – and particularly about the consequences or implications of evolutionary theory, cosmology, and naturalism for religious belief? How might further discussion of these issues be pursued? It is clear that, today, many would say that religion is under fire from science – and that science is under fire from religion as well. As noted above, this has occurred at the 'micro' level, in biology, at the 'macro' level, in cosmology, but also at the ontological and epistemological levels, when questions of scientific method, empirical evidence, and naturalism are raised. Yet while the discussions have sometimes been heated, they are not obviously intractable.

The essays in this volume remind us that, as we consider the challenges of science to religion, we must be specific and precise about what the challenges are – for example, whether they are empirical or rooted in method – and about exactly what conclusions are to be drawn from them. We must consider, for example, that the fact that much of the current debate is taking place within a discourse permeated by science may itself influence the options that we think are available to us.

Many of the essays here reflect the view that science and religion both seek to explain, that science *can* challenge religion on matters concerning which truth is possible, that religion cannot ignore nature and the results of empirical science, but that the tensions between science and religion are not as great as often thought. Taking refuge in the claim that the science and religion debate is irresolvable is not a viable option for either the believer or the sceptic. For example, it seems to be agreed by many of the authors that religion provides at least added value (such as an interpretive structure or worldview) to the data of empirical science. And the authors tend to hold that truths of religion are commensurable with truths of science.[24] Nevertheless, these views are far from settled. Does giving priority to empirical evidence undercut religion? And does seeing religion as something that provides added value not place it in a permanent ancillary role, subordinate to both scientific fact and scientific theory? We should not hesitate to question the terms or the framework of the debate.

The precise relations between religion and science are, undoubtedly, complex. This is not in the least because of the different ways in which the terms 'science' and 'religion' have been used in debate and, in general, of how science and religion have been engaged in. A fruitful discussion of these relations, then, requires awareness of from whence the challenges of science have come, of the place of proof and where the burden of proof lies, and particularly whether the terms involved have been properly, unambiguously, and consistently understood. Before we can go further on these issues, we have to look very closely at the nature of religion and science.

The preceding point reminds us that making further progress requires returning to, and clarifying the underlying conceptual issues involved. More needs to be said, for example, on what it is about religion and science that leads to this apparent tension or conflict. Is the conflict simply one of 'overlapping magisteria' (to use Gould's expression) – where one or the other party makes claims that are outside its realm of competence? Or is it something that goes to the core of religious belief, on the one hand, and scientific method and practice, on the other? How is it that

religious belief (or what is fundamental to it) might be affected by contemporary science and technology? What is religious belief, and what is its relation to empirical phenomena, or to evidence, or to 'the natural world'? Possible differences in methodology are relevant here as well. Much recent debate has also focused on naturalism, how theists need to respond to it, and whether a scientific commitment to naturalism precludes non-natural (for example, religious) entities or activities. Thus, an ongoing line of investigation has been to consider whether one can clearly distinguish kinds of naturalism and what this entails for religion. As noted earlier, it may mean reconsidering the meaning of key terms. We may have to understand religion differently – as involving not just a set of propositions, but sets of commitments, trusts, and practices.[25] And we may also have to understand science differently – as involving different kinds of practices and trusts.

Raising the question of how science might challenge religion – or of how religion and science are related – need not, of course, imply that one believes that there is a single, comprehensive answer. Instead, it may be that, as we carry out investigations and analyses, we will find that there are a number of different specific ways in which they are related, and that we will see how this or that religious institution, or this or that religious practice, or this or that religious belief fits with this or that scientific institution, or scientific practice, or scientific claim. (This would suggest that, if we are successful, we might even be able to carry out similar 'comparisons' among other sets of normative and descriptive institutions and practices, such as science and ethics, ethics and religion, aesthetics and religion, and so on.)

The debates concerning science and religion are powerful ones, but it is important to remember that they are not issues of science or religion as such, but philosophical issues. The authors in this volume contribute to these debates, but they also show that the issues are often far from settled. Their essays, then, leave us with a challenge. As these debates continue, not only must we be attentive to what is presupposed and to what has motivated – and motivates – the various critiques, but, most of all, we must take care not to yield to the passions, the polemics, and the too-easy answers that this issue has often inspired.

Notes

1 The term 'religion', here, is taken to refer to systems of belief, including beliefs about non-natural beings, and so would include theology. Of course, religion refers to much more than this; this is a matter that will be dealt with later in this Introduction, and discussed in the essays in this volume.

2 Whitehead, *Science and the Modern World* (New York: Macmillan, 1925).

3 Ibid., p. 18.

4 Ibid.

5 *Rocks of Ages: Science and Religion in the Fullness of Life* (New York: Ballantine, 1999).

6 See Holmes Rolston, III, 'Scientific and Religious Logic' (from *Science and Religion: A Critical Survey* (New York: Random House, 1987)) in Michael

Peterson et al (eds), *Philosophy of Religion: Selected Readings* (New York: Oxford University Press, 1996), pp. 467–8.

7 Augustine writes, for example: 'In the matter of the shape of heaven, the sacred writers did not want to teach man facts that would be of no avail for their salvation.' *St. Augustine: The Literal Meaning of Genesis*, trans. John Hammond Taylor (2 vols (Ancient Christian Writers vols. 41–42), New York: Newman, 1982), vol. 2, ch. 9.20.

8 For D.Z. Phillips see, for example, 'Belief, Change, and Forms of Life: The Confusions of Externalism and Internalism', in Frederick Crosson (ed.), *The Autonomy of Religious Belief* (Notre Dame: University of Notre Dame Press, 1981) and *Belief, Change and Forms of Life* (Atlantic Highlands, NJ: Humanities Press, 1986). For Peter Winch see his 'Discussion of Malcolm's Essay' in Norman Malcolm, *Wittgenstein: A Religious Point of View?* (Ithaca, NY: Cornell University Press, 1994); see also my review of Malcolm in *The American Catholic Philosophical Quarterly*, 71/1 (1997): 126–30.

9 Frederick Crews, 'Saving Us from Darwin', *The New York Review of Books*, 4 and 18 October 2001.

10 'Put Your Money on Evolution', *The New York Times* (9 April 1989) section VII, p. 35.

11 See his 'Ignorance Is No Crime', *Free Inquiry*, 21/3 (2001): 7–8.

12 *Darwin's Dangerous Idea: Evolution and the Meanings of Life* (New York: Simon & Schuster, 1995).

13 See Gay, this volume, pp. 19–38.

14 See, for example, Charles Darwin, 'M Notebook (July 1838 – October 1838)', discussed in Lamoureux, below.

15 Lamoureux, this volume, pp. 39–54.

16 Peacocke, this volume, pp. 73–88.

17 This seems to be the conclusion of some recent books, such as Simon Singh's *Big Bang: The Origins of the Universe* (New York: Harper Collins/ Fourth Estate, 2004). Singh quotes Robert Jastrow, who was Chief of the Theoretical Division of the National Aeronautics and Space Administration (1958–61): '[The big bang theorist] has scaled the mountains of ignorance; he is about to conquer the highest peak; as he pulls himself over the final rock, he is greeted by a band of theologians who have been sitting there for centuries.' See Robert Jastrow, *God and the Astronomers* (New York: W.W. Norton, 1978; 2nd ed. 2000).

18 E.T. Whittaker, *The Beginning and End of the World* (London: Humphrey Milford, 1952), quoted by Robert Jastrow, *God and the Astronomers*, Chapter 6, p. 102.

19 See Feist, this volume, pp. 121–130.

20 See, for example, Alvin Plantinga, 'Is Belief in God Properly Basic?', *Nous*, 15 (1981): 41–52; see also his *Warranted Christian Belief* (Oxford: Oxford University Press, 2000).

21 William P. Alston, 'A "Doxastic Practice" Approach To Epistemology' in Marjorie Clay (ed.), *Knowledge and Scepticism* (Boulder: Westview Press,

1989), pp. 1–29. See also his *Perceiving God: The Epistemology of Religious Experience* (Ithaca, New York: Cornell University Press, 1991).

22 See Drees, this volume, pp. 169–184.

23 See Armour, this volume, pp. 199–216.

24 Recall R.G. Collingwood's example of an artist and a scientist observing a sunset: 'The scientist "sees" in the sunset a concrete embodiment of certain scientific laws; the artist "sees" in it a harmonious pattern of colours.' (*Speculum Mentis* (Oxford: Clarendon Press, 1924), p. 62).

25 See, for example, my 'Religious Belief, Meaning and Argument', *Studies in Religion/Sciences religieuses*, 36/1 (2007): 41–64.

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PART I
History and Contexts in Biology and Evolutionary Theory

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Chapter 1

‘The Declaration of Students of the Natural and Physical Sciences’, revisited: Youth, Science, and Religion in mid-Victorian Britain[1]

Hannah Gay

Introduction[2]

Theological questions were under debate in Europe and North America even before the publication of Darwin’s *Origin of Species* in 1859. New Biblical criticism, much of it originating in Germany and France, had raised serious questions as to how the Bible should be interpreted.[3] The new criticism took note of scientific, philological, archaeological and historical work that together threw doubt on biblical history and on long-held theological positions.

In England, theological issues were especially debated after the 1860 publication of *Essays and Reviews*, a collection of essays by self-identified ‘progressive’ churchmen.[4] The Essayists wanted to see many of the new ideas acknowledged, together with an accordingly liberal interpretation of the Bible. At the time, *Essays* raised far more controversy than had Darwin’s *Origin* published a year earlier[5]; the British Library catalogue lists 99 published responses. Ecclesiastical legal challenges were mounted against two of the authors. Another, perhaps more famous, legal case, of roughly the same date, relates to J.W. Colenso, Bishop of Natal. In 1862 he had published a work in which the literal truth of much of the Pentateuch was denied, and for this he had been dismissed from his post by the Bishop of Cape Town, Robert Gray.[6] The legal challenges against the Essayists were, however, lost on appeal to the Privy Council, and Colenso’s appeal against his dismissal was won, and he was returned to his see.

The result of all this litigation was viewed by many as a triumph of secular over ecclesiastical authority. Many scientists had rallied behind the Essayists and Colenso in their legal fights. William Spottiswoode and John Lubbock campaigned to get signatures on a memorial of support for the Essayists. Charles Darwin, Charles Lyell and George Airy were among those who signed, but many also refused.[7] One who refused was John Herschel who later also declined to sign the ‘The Declaration of Students of the Natural and Physical Sciences’.[8]

As Owen Chadwick has pointed out, most scientists, and many clergymen, had jettisoned belief in much of the historical content of the Bible well before they knew about Darwinian evolution.[9] But this should not imply that most scientists had, more generally, jettisoned their religious beliefs – on the contrary. Most did not follow the

path of T.H. Huxley, Francis Galton or John Tyndall, either towards agnosticism or towards a radical naturalism, and many distanced themselves from Spottiswoode and Lubbock's memorial and their support of Colenso.[10] However, the general religious anxiety spawned a number of declarations. One of some importance was organized by a group of High Anglicans, disturbed by the legal outcome in the cases of the Essayists. Edward Pusey was the principal figure behind what is known as the Oxford Declaration. This circulated among Anglican clergymen who were asked to add their signatures in support of the position that the Church of England maintain 'without reserve or qualification' the inspiration and divine authority of the Bible.[11] Just under 50 per cent (that is, 10,906) of the clergymen in England and Ireland signed.

In addition to upholding the biblical account of creation, Pusey believed it wrong also to dismiss the idea of the fear of hell, as had been suggested by some of his more liberal contemporaries, including some of the Essayists. The loss of such fear, he claimed, would put people's souls at risk.[12] He was very critical of *Essays and Reviews* and regarded it as folly for A.P. Stanley, the new Dean of Westminster, to have written in defence of the volume. The Bishop of London, A.C. Tait, agreed with Pusey in this, and thought that the authors were causing an unnecessary crisis among laymen.[13] Indeed, people did begin to discuss the question of whether it was right for men who disbelieved the literal truth of the book of Genesis to become clergymen. In the minds of some among the public, the ideas of the new geology, and the even newer evolution theory, were anti-religious, which is what Tait had feared would happen as a result of all the public declarations. T.H. Huxley weighed in by stating that clergymen should stop accusing scientists of stirring up controversy; scientists, he claimed, were simply uncovering the truth in rational ways.[14]

The Oxford Declaration was successful in that the convocation of bishops did condemn *Essays and Reviews* in 1864, though, in many quarters, they were ridiculed for having done so. It is in this context that the activities of the young men to be discussed below must be understood.

The Declaration of Students of the Natural and Physical Sciences

A few historians have already written about the Declaration, but I would like to spell out the details, as I understand them, for two reasons: first, to recover more of the history of this interesting episode and, second, to offer an interpretation which takes the position of the young protagonists more seriously than do any of the earlier accounts.[15]

Herbert McLeod (1841–1923), the principal organizer of the Declaration, was born in London, the son of Scottish parents who had moved south to start a brewery business with some of their relatives. The business failed and McLeod's father found work as an employee in a brewery outside London. The family became very poor; McLeod left school at the age of 14 and worked part-time in yet another brewery while taking chemistry lessons from George Ansell at the Royal Panopticon in Leicester Square. Since McLeod showed great ability, Ansell advised him to enrol at the Royal College of Chemistry in the following year (1856). A.W. Hofmann, the professor

at the Royal College, was also impressed with McLeod's ability, and soon waived his fees.[16] By 1860, no longer a student, McLeod had become Hofmann's lecture assistant, and official chemist to the Royal School of Mines. His duties involved preparing and performing all the practical demonstrations for Hofmann's lectures, and carrying out chemical analyses for the professors in the School of Mines.

McLeod was a seriously religious young man. In his diary he records having attended services at 104 different London churches during the 1860s. Westminster Abbey, his Sunday favourite early in the decade, was attended over 500 times and St Lawrence Jewry was attended almost as often later in the decade.[17] On weekdays he attended churches closer to the Royal College of Chemistry which was situated on Oxford Street. He often attended church with one or two friends, usually others from the College. At Westminster Abbey he made new friends; one of these was a canon at the Abbey, Christopher Wordsworth, who was opposed to the appointment of Arthur Stanley as Dean. Indeed, it may be in part due to this appointment that McLeod later preferred to worship at St Lawrence Jewry.[18] Another friend was an Abbey congregant, William K. Salmon, who was to sign the Declaration. Salmon, a wealthy older man, had a large estate in Bridgend, Wales, took a keen interest in the Royal College of Chemistry, supported Hofmann in a variety of ways, and even attended some of his lectures.[19] Also at the Abbey, McLeod met Sir James Alderson, a president of the Royal College of Physicians, and remained on friendly terms with Sir James and Lady Alderson for the rest of their lives. Sir James was related to Robert Cecil, the Marquess of Salisbury, whom McLeod was to meet in the late 1860s, and with whom he formed a close friendship. At first this was based on the help McLeod was able to give the Marquess in his electrical experimentation, but the friendship developed into a lifelong one. By the end of the decade, McLeod had begun his frequent visits to the Cecil homes: at Arlington Street in London, and Hatfield House in Hertfordshire. There he befriended the Cecil children and taught them some science.[20] McLeod had a further connection to the Marquess through Lord Sackville Cecil, the Marquess's younger half-brother, to whom he was far closer in age. Sackville Cecil attended the Royal School of Mines in the early 1860s as an occasional student and became a close friend. The Cecils and the Aldersons were also High Anglicans, which will have helped smooth the relationships.[21] It was also through the Aldersons, Wordsworth, and his other Abbey connections, that McLeod became embroiled in church politics. He was among many who approved Pusey's Declaration and was something of a Pusey acolyte, attending Puseyite meetings whenever he could, together with his friend Alexander Gillman.[22] They also attended public scientific lectures together, and McLeod disapprovingly notes seeing Colenso at some of these.[23] McLeod had read Darwin's *Origin* already in 1860 and largely accepted its conclusions; so evolution, per se, was not an issue in his disapproval of Colenso.[24] He believed that, when properly understood, the book of Genesis and evolutionary theory would be seen to be consistent.

From McLeod's diary it would appear that the idea of yet another Declaration came from Gillman, who had recently left the College and had begun work as a brewery chemist in Southwark. In early April 1864, he wrote to McLeod asking him to write a letter from the College to the English Church Union 'declaring that we had no connection with those who study "science falsely so called" and to get

it signed as numerously as possible'.[25] What prompted Gillman was that some non-scientists were seen as actively using what they understood of the new science to undermine religion. That, together with the fact that some scientists were using science to challenge Church authority, was something from which both young men wished to distance themselves. Gillman's idea was that scientists needed to tell the world that one could be both a serious scientist and a serious Christian. On hearing from Gillman, McLeod immediately went to talk over the idea of a new Declaration with some of his clergyman friends, including Wordsworth. McLeod wrote a couple of drafts, Gillman made some suggestions, and a third draft was then sent to Wordsworth for his comments.[26] In his diary, McLeod noted that he received a 'most kind letter' from Wordsworth with suggestions as to how the wording of the Declaration might be improved.[27] McLeod then made a neat and corrected copy which, in its final iteration, read as follows:

> The Declaration of Students of the Natural and Physical Sciences[28]
>
> We the undersigned Students of the Natural Sciences desire to express our sincere regret, that researches into scientific truth are perverted by some in our own times into occasions for casting doubt upon the Truth and Authenticity of Holy Scriptures. We conceive that it is impossible for the Word of God, as written in the book of nature, and God's word written in Holy Scripture to contradict one another, however much they appear to differ. We are not forgetful that Physical Science is not complete, but is only in a condition of progress, and that at present our finite reason enables us only to see as through a glass darkly; and we confidently believe, that a time will come when the two records will be seen to agree in every particular. We cannot but deplore that Natural Science should be looked upon with suspicion by many who do not make a study of it, merely because of the unadvised manner in which some are placing it in opposition to Holy Writ. We believe it is the duty of every scientific student to investigate nature simply for the purpose of elucidating truth, and that if he finds that some of his results appear to be in contradiction to the written word, or rather to his own *interpretation* of it, which may be erroneous, he should not presumptuously affirm that his own conclusions must be right, and the statements of Scripture wrong; rather, leave the two side by side till it shall please God to allow us to see the manner in which they may be reconciled; and, instead of insisting upon the seeming difference between Science and the Scriptures, it would be as well to rest in faith upon the points in which they agree.[29]

An earlier version contained also a final paragraph omitted later. Perhaps the omission was because the intent of McLeod and his friends was also to canvas the signatures of non-Anglicans. Or, perhaps, to gain as many scientists' signatures as possible, they did not wish to be publicly identified too closely with the Oxford Declarationists. Whatever the case, they omitted the passage below:

> We therefore pray, that the Bishops and Clergy in Convocation assembled, and of the Church of England, will do all in their power to maintain a harmonious alliance between Physical Science and Revealed religion.

As soon as McLeod had copied out the declaration he rushed off to show it to another of his close friends, Charles Groves (1841–1920). Groves, who had agreed to sign

the Declaration when the two had met at Westminster Abbey on the previous Sunday, had recently left the College and was working as assistant assayer to John Stenhouse FRS (1809–90). Stenhouse had studied with Justus Liebig in Giessen, was assayer to the Royal Mint, carried out research on narcotics, and was well known in the scientific community. He had a private laboratory on Rodney Street, near King's Cross, and was a seriously religious Presbyterian.[30] After McLeod had shown the Declaration to Groves, he asked him to see whether Stenhouse would lend his support. Groves disappeared into Stenhouse's office at the back of the laboratory and some time later McLeod was ushered in.[31] Stenhouse gave his approval, and permission for his business address to be used for any correspondence on the Declaration; this, because it was anticipated that the College authorities might not be so willing. Stenhouse advised McLeod and Groves to first seek the signatures of Michael Faraday and Richard Owen, seen as pious senior scientists. McLeod immediately went to the Royal Institution to look for Faraday, but the porter told him that Faraday was too tired and that he should return the following day, which he did. Faraday encouraged McLeod, but he himself refused to sign. He wished to distance himself from the Anglican Church 'being a dissenter' and 'did not think the clergy had any right to interfere in the matter [of science]'.[32] The view that the clergy should not have any say in science was commonly expressed by those who refused to sign. For example, John Herschel and the Duke of Argyll agreed with Faraday on this point.[33] However, Faraday continued to take a sympathetic interest in the Declaration and later, learning of the many signatories, wrote, 'I am glad to see the names of so many who are to a certain degree like minded.'[34] Richard Owen also refused to sign and wrote a rather convoluted letter to McLeod giving his reasons. He stated that by signing such a document 'estimable fellow Christians' were implying that scientists could be anti-religious, which was a 'damaging and, I trust, an unfounded accusation'.[35]

Despite these initial setbacks, McLeod and his friends rightly believed that the Declaration expressed views with which many would have sympathy. Even among the people who refused to sign, there were those who, like Faraday, agreed with its content. It is also worth noting that some scientists refused to sign because they thought the statement too liberal.[36] It allowed that both biblical criticism and science were works in progress. It asked that scientists be free to seek truth. It claimed that when the bible was properly interpreted and when scientific truth was finally reached, there would be no inconsistency between them. But for many, this was a move down a slippery slope. The idea that scientific and biblical truths were to be consistent challenged the view that science, independent of religion, was the route to truths about the natural world. It prompted some to act quickly to ridicule the Declaration and its protagonists.

Further Work on the Declaration and Reactions to it

Between 10 April and 22 April 1864, McLeod, Gillman and Groves busily made copies of the Declaration and sent them off to a growing list of scientists. By 22 April, realizing that this was too laborious, McLeod ordered 1,000 copies from a printer.[37] He also sought further help in writing covering letters and in seeking out people to

sign their Declaration. Another two of Hofmann's assistants at the Royal College of Chemistry, David Howard (1839–1916) and Capel Berger (1839–68) became willing helpers.[38] Howard had good business connections; he was the grandson of the chemical manufacturer Luke Howard, and the great-grandson of the founder of Lloyd's Bank. Despite these Quaker roots, Howard was another High Anglican. He later joined the family chemical manufacturing firm in Stratford, East London, and remained a good friend of McLeod's through life.[39] Berger was another close friend; he and McLeod often helped each other with their work. Berger's immediate family were members of the Plymouth Brethren and Berger was likely responsible for getting family friend Philip Gosse, a fellow Brother, to sign the Declaration.[40]With Stenhouse and Berger on side, and from the attempt to have Faraday be the first to sign, it is clear that this was not to be a sectarian enterprise. Indeed, many Catholics and people of different Protestant denominations signed the Declaration. William Crookes, an earlier Hofmann assistant, agreed to advertise it. He wrote saying he approved of the memorial, but did not think it would do much good and that he, himself, would not sign. But he agreed with one of the main points the Declarationists were making: 'I have the utmost reverence for the word of God as written in Holy Scripture and have confidence that time will show that many of the discrepancies between science and religion will prove more apparent than real.'[41]

By July, when it had become clear that a major undertaking was underway and that many scientists had already signed,[42] disapproving editorials, articles and letters began to appear in the press. The *Daily Telegraph* carried an editorial on the Declaration on 22 July, likening the young men to highwaymen who, by using the post, were sending a document that demanded 'your opinion or your character'. The polemic ended by stating that if the post was going to be used in this way, then perhaps Rowland Hill did not deserve the pension given him by the State.[43] On the same day, an anonymous letter, signed Y, appeared in *The Times.* McLeod soon discovered that Y was John Percy, Professor of Metallurgy at the Royal School of Mines. Percy called the Declaration 'a vague confession of faith' and challenged McLeod's authority. He pointed out that McLeod was only a lowly employee of the (government) Department of Science and Art which operated the Royal School of Mines, and accused him of 'officious meddling' and that 'he has certainly not yet attained the position of an authority in science'. Further, while 150 people had already signed, Percy claimed that many of these were similarly lacking in scientific authority. While it was true that about forty of the signatories were young students and assistants, most were more senior. It would appear that Percy was upset by the initial success of the petitioning and was overreacting: 'You may be assured that men of science of recognized position in this country will generally repudiate the McLeod "Declaration".' This was not strictly true, but Percy's point, 'let men of science mind their own business, and theologians theirs', was one with which many scientists agreed. Percy believed in different types of truth and that, in so far as nature was concerned, scientists were the experts. He also stated a debatable, but commonly held historical view; namely, 'time was when the voice of science was everywhere stifled by ecclesiastical power; but that voice has at length made itself heard and respected.' Men like Percy who, with some difficulty, had made professional careers in science were keen to protect their turf from traditional authority. T.H. Huxley,

Percy's colleague at the Royal School of Mines, was becoming an even better known protagonist for science and its authority. He wrote to McLeod: 'I must decline to append my name to a document of which I so thoroughly disapprove.'[44] McLeod was not especially concerned by the disapproval of the professors and, on learning that Y was Professor Percy, was in no way deterred from his project. He had the continuing support of clergymen such as Wordsworth and the Reverend Harford of St Mark's, and of some of the influential congregants at Westminster Abbey.

There are many examples that could be cited to demonstrate McLeod's confidence. An amusing one is the occasion when he decided to stir things up at the Royal School of Mines. He asked some of his young fellow-Declarationists to join him in the front row of one of Huxley's lectures. They waited to see whether Huxley would 'pitch into us', no doubt hoping he would. But Huxley did not rise to the bait.[45] For some years Huxley had been fighting what he saw as old fogeys, that is conservative elements in the Royal Society and in the religious establishment who resisted some of the new scientific ideas. More importantly, they resisted sharing power and influence with a professionalizing class increasingly made up of people (like him) from outside the upper classes. Now he had also to face a set of young fogeys, most of who came from class backgrounds not unlike his own.[46] Like Huxley, many other important scientists opposed the Declaration, but few will have shared his total antipathy to its theology. Even John Tyndall, who likely shared his views, was polite in his letter to Berger. While refusing to sign, he wrote that he did not think there was much serious opposition to science in the country and that he sympathized with 'the spirit of liberality' which characterized the Declaration. Perhaps Tyndall was being hypocritical. On hearing that James Joule had signed, he wrote to the chemist, Heinrich Debus, telling him that Joule had 'put his name to that drivelling declaration'. [47]

Many who refused to sign did so on largely political grounds; either for reasons of not wishing to create further public discord, or for reasons of not wishing to be aligned with conservative elements.[48] But, as Owen Chadwick has noted, many scientists of the mid- to late-Victorian period were devout: 'we find a fair number of leading scientists quietly practising their faith in church or chapel .... And, even more, we continue to find that old axiom or feeling ... that scientific study can lead upwards towards God. Faraday felt it; Kelvin never doubted it; the most eminent among Victorian medical men ... were marked for their piety.'[49] McLeod, while not overtly expressing acceptance of the 'old axiom', presumably held it to be true. As Frank James has pointed out, the organizers, and those who signed the Declaration, were representative of 'the overwhelming orthodoxy of professional scientists at the time'.[50] But piety did not necessarily mean support for the Declaration, as has been noted in the case of Faraday. Similarly, George Stokes, Lucasian Professor of Mathematics at Cambridge and Secretary of the Royal Society, wrote an interesting letter to Groves in which he stated that he did not think a reconciliation of scientific and religious ideas would come in this world. He believed it to be part of 'God's plan of dealing with Man not to make the evidence for revealed truth apparent', but nonetheless God has given us a 'love of the truth' and that we have to live with inconsistency as 'part of our natural probation'. He thought it presumptuous to 'assume that all our local difficulties will eventually be cleared up', and had no

wish to add his signature which would put him in a position of having his views misrepresented.[51]

Unlike Faraday and Stokes, some scientists were keen to make their position public. For example, John Herschel and John Bowring, a Catholic and major world traveller, both wrote letters to the *Athenaeum* (correspondence that was reprinted in *The Times*). Herschel (who had been asked by his son Alexander to sign) perhaps wanted to give him a lesson by stating that he found it 'an infringement of that social forbearance which regards the freedom of religious opinion in this country with especial sanctity' that he be 'called upon publicly to avow or disavow ... in writing, any religious doctrine or statement, however carefully or cautiously drawn up'.[52] The wording here suggests a distaste for religious tests more generally, a distaste shared also by other critics. For example, Bowring stated that while he agreed with the claim that all truths must harmonize, he wanted the utmost latitude in enquiry both in matters relating to the Bible and to science; the day was past when anyone should tie themselves to any kind of public confession. Charles Daubeny, Professor of Botany at the University of Oxford, had already written to *The Times* in July enclosing his reply to McLeod's request. He noted that while there was much in the tenor of the Declaration with which all Christians must sympathize, the issuing of such a document was 'of doubtful expediency' and would be 'likely to lead to much misconception' since it might lead non-scientists to believe that 'persons devoted to the study of nature are peculiarly liable to the charge of infidelity'. Some people, he stated, 'take a perverse pleasure in opposing received doctrines', but he did not think that they were principally scientists. The most outspoken attack on received doctrine, he noted, had come from 'an Anglican bishop, of some mathematical, or at least arithmetical reputation certainly; but one who, so far from being addicted to the study of nature, betrayed how little his pursuits in early life had taken that direction by confessing that the first doubts which came across his mind as to the reality of an Universal Deluge had been suggested to him in Africa by a native convert.' Thus, Colenso was being used to illustrate the fact that criticism of ecclesiastical authority could come from within the Church, and from those who had not been scientifically educated.[53] While Daubeny refused to sign and believed that scientific men 'as scientists' should not engage in religious matters, he wanted to make his position public in order that people should not imagine that scientific men 'are often either opposed or indifferent to religious truth'.[54]

Thus, it seems fair to say that many important scientists were sympathetic to the content of the Declaration but saw the whole exercise as wrong-headed, and possibly harmful to the cause of science. But some people were totally opposed and made capital out of the fact that many eminent scientists had refused to sign. They used their rhetorical and polemical skills to pour ridicule on the organizers of the Declaration. Perhaps the most acerbic critic was Augustus De Morgan FRS, Professor of Mathematics at University College London.[55] De Morgan wrote anonymous articles in both the *Athenaeum* and the *Saturday Review*, though McLeod and many others knew that he was the author. De Morgan made much of John Herschel's refusal to sign, and that very few others 'of the leading scientific names have been affixed to the proposed declaration'. 'The Inquisitor,' he wrote, 'is extinct, yet like other fossil animals, he has left a reduced and degenerate specimen of his class to

represent him to the existing generation. The nearest approach to him that we can boast is to be found in the sort of people who get up theological declarations.' He stated that the motive of those organizing the Declaration 'at this particular moment' was to 'give a general endorsement to the traditional interpretation of the book of Genesis. ... A good deal of the complaint which the so-called religious world and its organs are constantly uttering against men of science is simply the expression of their own fears.' He noted that the new science had shown the traditional creation story to be false: 'science has made wild work with the traditional beliefs ... and the more unreasoning portion of the religious world have thought fit to represent the truth of the Christian revelation as being put to hazard by these speculations.' As a sop to the other side he added, 'but the men of science are not quite blameless in the matter. Some of them seem to value their studies, as an Orangeman values his religion, chiefly for the opportunity it gives them of making their natural enemies uncomfortable.'[56]

The rhetoric of 'natural enemies' was a construction. As has been noted, most men of science did not see their work as being in any way 'naturally' opposed to religious belief. Further, a disinterested reading of the Declaration would not have prompted this response. But the rhetoric suited the purpose of those who were striving to positions of importance in society. In trying to marginalize the organizers of the Declaration, by stressing their junior and lowly status in the scientific firmament, people like De Morgan and Percy, though relatively senior, reveal their own fear of marginality. In October 1864, De Morgan was still vigilant, albeit ignorant of the views of some of the people he cited: 'the value of a scientific protest in which the great chiefs of science – Herschel, Owen, Faraday, Whewell, Airy, Lyell, Murchison, Tyndall, Sabine – refuse to join, may be imagined.'[57] And he pointed to what he considered an absurd error for anyone in the know: 'Mr. Berger informs us that Adam Sedgwick M.D. is really Professor Sedgwick, of Cambridge. ... How Professor Sedgwick, Prebendary of Norwich, comes to be designated as M.D. we do not know.'[58] But Sedgwick, albeit at first wrongly titled, did sign the Declaration, one of several eminent scientists to do so. Later, in a letter to Groves, Sedgwick wrote of the Declaration, 'Sir John Herschel regarded it, I think, as a kind of new religion ... I regarded it as a kind of peace offering by a body of men who were honestly searching after truth.'[59] In this he appears to imply that Herschel saw the Declaration as something akin to a fortieth article of the Anglican Church – an interpretation that, at least, accords with Herschel's own statement above. De Morgan expressed a similar view in November 1864 when, in a signed article entitled 'Scripture and Science', he noted that now he, too, had received a request to sign the Declaration, but he dismissively wrote that the request, that 'solicits the favour', was like 'a grocer's application for tea and sugar patronage'. Of course he would not dream of signing. 'For two months I have crowed in my own mind over my friend Sir J. Herschel, fancying that the promoters instinctively knew better than to bring their fallacies before a writer on logic.' And, 'the kind of test before me is the utmost our time will allow of that inquisition into opinion which has been the curse of Christianity ever since the State took Providence under its protection.'[60]

To counter attacks in the press such as this, McLeod wrote to the natural philosopher Sir David Brewster for advice. Brewster, Principal and Vice-Chancellor

of the University of Edinburgh, and one of the signatories, replied that those who refuse to sign the Declaration for the reasons given by Herschel and De Morgan 'cannot believe that the Bible is the Word of God'.[61] Encouraged, McLeod later approached Brewster to write an introductory note to a list of supportive letters that he had received and was intending to send to *The Times*, to counter the negative ones already published. But Brewster refused and, in a later letter to Capel Berger, gave his reason. While he was 'anxious to do what was right in so great a cause', he had consulted Professor J.H. Balfour, another of the signatories, who thought that such a move would not be well received by the editor of *The Times*. Brewster feared a counter-attack, one which would draw him into a long-drawn-out correspondence, something that, at his age, he felt unable to cope with.[62]

It took over a year for the Declaration to be made public with all the signatures, and opponents made much of the delay in publication. The organizers were taking their time in trying to obtain as many signatures as possible, and would perhaps have extended the time before publication had not Professor Hofmann decided to leave London and take a post in Berlin. He wanted McLeod to go with him for a few months to help set up his new laboratory. McLeod was reluctant to do this, but after Hofmann raised the amount he was willing to pay for his services, and after McLeod's mother told him that he could not afford to turn down such an offer, he agreed to go.[63] He left in April 1865, and Capel Berger, who had helped find some of the signatories, agreed to take over the publication of the Declaration. It is for this reason that Berger's signature is the last one on the list, and that it is in his handwriting that the names of those who had given verbal agreement were inserted. It is also the reason why, after his premature death in 1868, Berger's family were left with some of the documents relating to the Declaration.

Consequences of the Declaration and some Concluding Comments

In so far as the larger world is concerned, the consequences of the Declaration were minimal. Few will have noticed its existence, and after 1865 it was soon forgotten. However, it is an interesting historical episode; it illustrates well the religious concerns of the time, and the ways in which scientists responded to them.

The publication of the Declaration, in June 1865, with the names of the 717 signatories, prompted a final article by De Morgan in which, like earlier, he ridiculed the whole enterprise. He made fun of the fact that the young men had claimed the Declaration to be from students of *both* the physical and natural sciences. He pointed out that 'the "natural sciences" as in the full title of the Royal Society includes everything', and that the inclusion of physical science was a redundancy, one that the protagonists were too ignorant to recognize. It is interesting to speculate what De Morgan would have said had he known of Brewster's role in the choice of title.[64] De Morgan restated his claim that important scientists had not signed, despite the fact that about one-tenth of Fellows of the Royal Society had done so. He believed that the proportion of signatories who had published in the Royal Society's *Philosophical Transactions* was a better measure of importance. He noted the large number of students who had signed, and declared 'we do not approve of college students as makeweights in a list which

professes to seek the signatures of men of established position'. Sarcastically, he noted that 'their signatures are to be deposited in the Bodleian Library where they will be interred with many a relic of the good old time.'[65]

What De Morgan failed to acknowledge was that many serious scientists *had* signed. They included, in addition to those already mentioned, Thomas Bell FRS, Professor of Zoology at King's College London, A. Bryson MD, FRS, Director-General of the Medical Department of the Royal Navy, James Challis FRS, Plumian Professor of Astronomy, University of Cambridge, William Clark FRS, Professor of Anatomy, University of Cambridge, F. Crace-Calvert FRS, Manchester chemist, James Glaisher FRS, astronomer at the Greenwich Observatory, John Hogg FRS, Foreign Secretary of the Royal Society, Percival Norton Johnson FRS, chemist, Robert Main FRS, Director of the Radcliffe Observatory, Henry Moseley FRS, and Thomas Rymer-Jones FRS, former student and colleague of Richard Owen, and Professor of Comparative Anatomy at King's College London. The list also includes many eminent medical men[66] and, interestingly, many geologists such as J.S. Bowerbank FRS and Robert Hunt FRS, Professor of Geology at the Royal School of Mines and Keeper of the Mining Records at the Museum of Practical Geology.[67] For those opposed to the Declaration it was perhaps the fact that many of the signatories were young that was disturbing. At least, that is what one might conclude from their criticisms.

William Brock and Roy Macleod see the Declaration as having been a 'desperate attempt' to maintain a harmony between science and religion in the face of new scientific knowledge and that it 'reveals a sense of fear, both of science and of biblical criticism', a view of the young men that echoes that of De Morgan.[68] They imply that the relation between religion and science at the time was one of confrontation, albeit complex. It would appear, however, that the major confrontational problems of the period were within the Anglican Church, and were far from being solely related to science. As John Tyndall had noted, there was not much religious opposition to science at that time and, it would appear, only a few scientists were actively challenging the church. Further, it seems wrong to think of the young men at the Royal College of Chemistry as making any kind of 'desperate' attempt at maintaining harmony between religion and science or being fearful of new ideas. They genuinely believed in such harmony, and did not see it as under threat. Rather, they should be seen as attempting to join in the important discourses of their day. They wanted to be taken seriously by senior churchmen and scientists – and they succeeded.

One could argue that there are two main strategies that young people can adopt for getting ahead and noticed. One is to distance themselves from the older generation, ally with other young people, and take new and original paths. This, roughly, was the choice made by T.H. Huxley who thought 'it is no use in putting any faith in the old buffers'.[69] Or, they can ally with conservative and senior forces and seek important mentors. McLeod had done this in the case of Hofmann, who relied on him in many ways, and helped also in promoting him within the College and, later, beyond. More generally it can be said that the College, under Hofmann, was a place that gave young students confidence to think for themselves, and to join in the debates of the day.[70] In McLeod's case, and for some of his friends, this extended to religious activities, and in these they had the sympathy, if not concrete support,

of their professor. The College, privately founded in 1845, had the early support of many major landowners and many from within the medical community.[71] Some of these people, such as William Salmon, took a personal interest in the students who, in turn, allied with their older mentors in a variety of ways. Outside the College, McLeod also found mentors among senior members of the Abbey community[72] and later he found Lord Salisbury. He had a great capacity for friendship and, from his diary, it would appear that many among the students and ex-students of the College remained friends for life.

Brock and Macleod also claim a 'serious confusion of objectives' in the Declaration. But, that the wording is vague on theology and on the nature of science was likely an advantage in gaining signatures. In this, McLeod appears to have been well advised by Wordsworth. One would not expect chemists in their early twenties to have had a sophisticated grasp of either philosophy or theology; nor would one expect them to be especially fearful of the consequences of new scientific ideas on traditional belief. Some of their contemporaries may have had such fears, but the young men under discussion here seem to have thought it nonsense that they could not be both seriously religious and good scientists at the same time. It is easy to fall into retrospective thinking given the later success of the then new geological and evolutionary ideas; but in the 1860s it was unclear what the future orthodoxy would be. A conservative stance was as good as any.

A reading of McLeod's diary for the 1860s leads to the conclusion that the Royal College of Chemistry had early on developed a corporate identity which gave many of its better students pride in the College association, as well as confidence in their own work. Further, the work/leisure boundary was ill-defined and much time outside working hours was spent with fellow students and assistants in a range of collective activities. While not all the students will have shared McLeod's views, at least forty-three who signed the Declaration were students or ex-students of the Royal College of Chemistry. McLeod's religious conservatism was clearly widely shared and it was even more widely tolerated. Because the College fostered a close and supportive fraternity, young assistants and students were given the confidence to join in a national debate.

It can also be argued that the professional lives of the chief protagonists were enhanced by their early entry into the politics of science and religion – it may well have been a good career move. McLeod and Groves later became Fellows of the Royal Society and Howard had a distinguished career in the chemical industry. More immediately, McLeod and Groves were helped by the professor who succeeded Hofmann, Edward Frankland. This occurred, despite the fact that Frankland was a close friend of Huxley and a fellow X-Club member.[73] Even Huxley sent work in McLeod's direction.[74] In McLeod's case his association with important congregants at Westminster Abbey and with the Cecil family helped his securing the position of Professor of Experimental Science at the Royal Indian Engineering College at Cooper's Hill in 1870.[75] He was successful despite the fact that several other applicants had better paper qualifications than he.[76] Supporting letters from Lord Salisbury and the Countess of Derby, mother of his friend Lord Sackville Cecil, helped in this, as did the fact that Lieutenant Colonel George Chesney, the first President of the new College, was a devout High Anglican who approved of McLeod's earlier activities.

By the 1870s, McLeod even records having friendly chats with Arthur Stanley, Dean of Westminster.[77]

Groves became a lecturer in chemistry to medical students. He was an active member of the Chemical Society, and editor of its journal. Berger, as mentioned, died young; Gillman became a brewery chemist. David Howard, a highly successful chemical manufacturer, was a founder of both the Institute of Chemistry and the Society of Chemical Industry.[78] While none of the five young men became major scientists, all demonstrated a high level of scientific seriousness, and three had distinguished careers.[79]All this points to the fact that their religious views, and their youthful religious activism, were no hindrance – and possibly even an advantage – to career progress in the new scientific age.

Notes

1 I would like to thank Anne Barrett, archivist at Imperial College of Science, Technology and Medicine for her help, and for permission to use the Herbert McLeod diary; and Godfrey Waller, Cambridge University Library, for his help, and for permission to use the Berger papers. I also thank William Sweet and the Canadian Jacques Maritain Association for inviting me to present an earlier version of this paper at their conference in May 2002.

2 Given that most of the contributors to this volume are concerned with conceptual and philosophical issues having to do with the relationship of science and religion, it is worth making the point that intellectual and cultural historians, among whom I count myself, are interested in the context in which new ideas emerge. Future historians will find interesting, and may question, why there was so much concern over matters relating to science and religion in the early twenty-first century. While it is the activities of an earlier generation of concerned thinkers that concerns me here, in thinking of then and now, I am reminded of an anonymous review, published in 1864, the year in which much of the activity to be discussed took place. The reviewer, who did not care for the Reverend W. Baker's *Harmonic Maxims of Science and Religion* (1864), hailed it as 'another of the unending series of works about science and religion, the comfort of which is that they die as fast as they are born' (*Athenaeum*, 26 November 1864, p. 706). From today's perspective, it is clear that such works are also born as fast as they die.

3 For example, David F. Strauss, *Life of Jesus; critically examined* (1835), trans. of 4th German edition by George Eliot (London: SCM, 1972).

4 Frederick Temple et al. (eds), *Essays and Reviews* (Farnborough: Gregg, 1970), facsimile edition, reprint of first edition (London, 1860). The other contributors were, Baden Powell, C.W. Goodwin, B. Jowett, M. Patterson, R. Williams, and H.R. Wilson. Goodwin was a layman, but an important Egyptologist; the others were all Anglican clergymen. Baden Powell was also a scientist and dealt with contemporary scientific issues in his essay. For further contextual discussion of this essay collection see John Hedley Brooke, *Science and Religion: some historical perspectives* (Cambridge: Cambridge University Press, 1991), pp. 271–4.

5 Joseph L. Altholz, *Anatomy of a Controversy: The Debate over Essays and Reviews* (Aldershot: Scolar Press, 1994).

6 J.W. Colenso, *The Pentateuch and Book of Joshua Critically Examined* (London, 1862). See also, Jeff Guy, *The Heretic: a study of the life of John William Colenso, 1814–83* (Johannesburg: University of Natal Press, 1983).

7 Horace G. Hutchinson, *Life of Sir John Lubbock: Lord Avebury* (Macmillan: London, 1914), pp. 57–8. George Biddell Airy FRS (1801–92), Astronomer Royal (1835–81); John Lubbock FRS (1834–1913), banker and natural scientist; Charles Lyell FRS (1797–1875), geologist; William Spottiswoode FRS (1825–83); President of the Royal Society (1878–83), natural philosopher and partner in the family firm of Eyre and Spottiswoode.

8 Sir John F.W. Herschel FRS (1792–1871), astronomer.

9 Owen Chadwick, *The Victorian Church*, 2 vols (London: Adam and Charles Black, 1970), vol. 2, pp. 6–7.

10 For Huxley's views on religion see Adrian Desmond's biography of Huxley: vol. 1 *The Devil's Disciple* and vol. 2 *Huxley: Evolution's High Priest* (London: Michael Joseph, 1994 and 1996). For the more general reaction to scientific naturalism, see Frank M. Turner, *Between Science and Religion: the reaction to scientific naturalism in late Victorian England* (New Haven: Yale University Press, 1974).

11 Chadwick, *The Victorian Church*, p. 84.

12 Chadwick, *The Victorian Church*, p. 84, for discussion of the Declaration and of Pusey's views.

13 Chadwick, *The Victorian Church*, pp. 84–5. Tait was a future Archbishop of Canterbury. Despite his criticism of *Essays and Reviews*, he did not approve the Oxford Declaration. Frederick Temple, one of the Essayists, was a future Bishop of London and Archbishop of Canterbury.

14 Chadwick, *The Victorian Church*, p. 7. Huxley was provocative. In his review of Darwin's *Origin*, he gleefully wrote, 'extinguished theologians lie about the cradle of every science as the strangled snakes beside that of Hercules.' Thomas Henry Huxley, *Collected Essays*; vol. 2, *Darwiniana* (London: Macmillan, 1893), p. 52.

15 E.G.W. Bill, 'The Declaration of Students of the Natural and Physical Sciences, 1865', *Bodleian Library Record*, 5 (1954–6): 262–7. This short account makes John Stenhouse and Capel Henry Berger the two chief protagonists of the Declaration, but provides no evidence to support the claim. I can understand how such a mistake was made and my own narrative will, implicitly, bring out what I believe to be the reasons for it. See also, W.H. Brock and R.M. Macleod, 'The Scientists' Declaration: reflexions on science and belief in the wake of *Essays and Reviews*, 1864–5', *British Journal for the History of Science*, 9 (1976): 39–66. These authors also see Berger as the main protagonist. However, they have given a good account of much of what happened and, in the matter of the signatories, far more systematic than anything attempted in this paper. Their paper is, however, biased towards the critics of the Declaration, and takes too presentist a stance towards religious views of the period. See also, Frank A.J.L. James, 'The Sacralisation of Science: The Scientists' Declaration, 1864–5', paper delivered at the Joint Conference of the British Society for the History of Science and the History of Science Society (US), Manchester, 11–15 July 1988. A copy is in the 'Program, Papers and Abstracts' distributed to conference participants. James's account of the religious context is one with which I largely concur. Further, unlike the earlier authors, James had access to Herbert McLeod's diary and rightly gives McLeod the leading role in what went on. This paper, too, makes extensive use of McLeod's diary. For a comprehensive treatment of the Darwinian debates in later decades, see, James R. Moore, *The Post-Darwinian Controversies: a study of*

the Protestant struggle to come to terms with Darwin in Great Britain and America 1870–1900 (Cambridge: Cambridge University Press, 1979). For a discussion of science and religion in the early twentieth century, see Peter Bowler, *Reconciling Science and Religion: the debate in early-twentieth-century Britain* (Chicago: University of Chicago Press, 2001).

16 Imperial College of Science, Technology and Medicine (henceforth IC) Archives: Herbert McLeod Diary, 1860–1923; Royal College of Chemistry; Council minutes, 1855–60.

17 Frank A.J.L. James (ed.), *Chemistry and Theology in Mid-Victorian England: The Diary of Herbert McLeod, 1860–70* (Microfiche), (London and New York: Mansell, 1987). The index (critical apparatus) to this transcription of the first eleven years of the McLeod diary allows the counting of church attendance.

18 This church was associated with mission work overseas and McLeod and several of his friends were active in supporting these activities.

19 IC Archives; McLeod Diary. See, for example 15 April 1861. Salmon is mentioned in the diary throughout the 1860s and into the early 1870s. In 1862 McLeod spent his summer vacation as a guest at Salmon's home in Wales.

20 IC Archives, McLeod Diary, many entries in 1870s and 1880s. See also, Andrew Roberts, *Salisbury, Victorian Titan* (London, 1999), pp. 114, 133, 205, 242, and 281. McLeod was midway in age between the Marquess and his children.

21 The term 'Anglican' was first introduced by John Henry Newman – from *Ecclesia Anglica*. The term 'High Anglican' may not be strictly historically correct since it is not clear how the Cecils. Aldersons, McLeod and Gillman would have termed their Church affiliation, but it is useful as an identifier.

22 IC archives; McLeod Diary; see, for example, 5 March 1863. Inspired by these meetings, McLeod and several of his like-minded friends bought large quantities of 'vegetable parchment' and constructed their own prayer books into which they copied their favourite prayers. See, for example, diary entry for 13 June 1862.

23 For example; IC archives; McLeod Diary, 6 March 1863. On this occasion the lecture was at the Royal Institution.

24 IC archives; McLeod Diary entries for 1860.

25 IC archives; McLeod Diary, 6 April 1864.

26 IC archives; McLeod Diary, 7–9 April 1864. Since Wordsworth was not at the Abbey when he went to seek him out, McLeod wrote to him about the Declaration. One of the other clergymen consulted was Harford, who preached at St Mark's, North Audley Street, and who 'approved "our protest"'. Harford (I have not yet discovered his full name) continued to support McLeod in this and other, more scientific, activities. For example, he lent him a variety of minerals for experiments. Harford was a friend of the artist Gustave Doré who so poignantly portrayed slum life in London (see diary entry, 21 July 1864) and may have been related to John S. Harford FRS who signed the Declaration.

27 IC archives; McLeod Diary, 14 April 1864.

28 The title of the Declaration was agreed on only shortly before publication in June 1865. Further details to be given below.

29 A copy of the Declaration, with many of the original signatures, was deposited in the Bodleian Library by Capel Berger. McLeod had earlier asked the British Museum to accept the document, but was refused. Further documents on the Declaration were deposited at the University of Cambridge Library, by the Rev. A.W. Berger. See note 38 below.

30 Earlier, Stenhouse had headed a lively chemistry department at St Bartholomew's Hospital, but had to retire after suffering a stroke from which he never fully recovered. Robert Bud and Gerrylynn K. Roberts, *Science Versus Practice: Chemistry in Victorian Britain* (Manchester, 1984), p. 107.

31 IC archives; McLeod Diary, 14 April 1864.

31 IC archives; McLeod Diary, 14–15 April 1864. Michael Faraday FRS (1791–1867), natural philosopher.

33 IC archives; McLeod Diary, 30 April 1864. McLeod reports that the Duke of Argyll approved of the theological content, but refused to sign because he saw no good reason for sending such a Declaration to the Convocation of Anglican bishops. On 12 May, McLeod notes that his friend Alexander Herschel had failed to persuade his father, John Herschel, to sign; but Alex, an astronomer–physicist like his father, not only signed, but helped in collecting signatures.

34 Cambridge University Library (henceforth, CUL), Add 5989; Faraday to Berger; 9 July 1864, Hampton Court.

35 CUL, Add 5989; Owen to McLeod; May 10, 1864 British Museum. Sir Richard Owen FRS (1804–92), naturalist.

36 This, for example, was the view of Anglican John Gladstone FRS, a wealthy and independent chemist. He held a more literalist view of the Bible than McLeod and disapproved of the Declaration's wording. Gladstone sent McLeod a pamphlet 'Antiquity of Man and the Word of God'; McLeod noted 'I think he has fallen into some fallacies.' IC archives; McLeod Diary, 23 April 1864. J.H. Lefroy FRS wrote to McLeod stating that while he approved the Declaration, he would not sign. He, too, did not see science as a danger to the Christian faith, but believed that biblical literalism was a serious threat, one that would subject the Church to ridicule. CUL, Add 5989; Lefroy to McLeod, 24 September 1864, Blackheath.

37 IC Archives; McLeod Diary, see entries 10–22 April 1864.

38 For an account of Lewis Berger and Sons, the Berger family firm of colour manufactures, see, Thomas B. Berger, *A Century and a half of the House of Berger* (London: Waterlow, 1910). In April 1864, Canon Wordsworth presented a copy of the Declaration, with just 28 signatures, to the Lower House of Convocation, but this was just the start of an effort to encourage many more scientists to sign. See memoir by Rev. A.W. Berger which is among papers that were donated to the Cambridge University Library; Ms Add 5989. Capel Berger, son of Lewis, died in 1868, at the age of 28. He was working in the laboratory of the family business, and choked on some carbolic acid he was pipetting by mouth (see IC Archives; McLeod Diary, 23 June 1868). His family later asked one of his old Harrow School masters, E.H. Perowne, a fellow of Corpus Christi College, Cambridge, what to do with the correspondence that Berger had received in connection with the campaign (many of the letters are addressed to McLeod, and some were to the other organizers; the collection is far from being a complete set of the Declaration correspondence). Since many of the approximately eighty letters in Berger's possession were from eminent scientists, Perowne thought the University of Cambridge might be interested in them (see his correspondence with Henry Bradshaw, librarian of the university; Bradshaw papers, CUL). Already by 1872, the Declaration was largely forgotten and Perowne thought the letters only of interest as a collection of autographs.

39 Howard, Gillman and Groves all became godparents to children of McLeod.

40 Philip Gosse (1810–88), marine zoologist.

41 CUL, Add 5989; Crookes to McLeod; 22 April 1864.

42 Among the early signatures were those of Thomas Anderson, Professor of Chemistry at the University of Glasgow, George Ansell, Assayer to the Royal Mint, David Brewster, FRS and Vice-Chancellor of the University of Edinburgh, J.H. Gilbert, FRS, James Joule, FRS, Henry D. Rogers, FRS and Professor of Natural History and Geology, University of Glasgow, Alfred Smee, FRS and John Stenhouse, FRS.

43 Another critical article appeared in the *Daily Telegraph* on 21 September 1864.

44 CUL, Add 5989; Huxley to McLeod, 15 June 1864; Royal School of Mines.

45 IC Archives; McLeod Diary, 9 November 1864. Despite his antipathy towards Huxley's views on religion, McLeod records enjoying many of Huxley's lectures. See, for example, Diary, 19 January 1861.

46 Huxley was then in his late thirties, the Declarationists were in their early twenties. It is possible that the aggravation of the Declaration was a precipitating factor in the formation of the X-Club in 1864. See, for example, the diary of Thomas Archer Hirst (Royal Institution Library). On 11 August 1864, Hirst records receiving a letter from Herbert McLeod asking him to sign a declaration deploring the 'casting doubt upon the truth and Authenticity of the Holy Scriptures'. Hirst notes that, of course, he refused to sign. Later, on 6 November 1864, he wrote, 'on Thursday Nov. 3 an event, probably of some importance, at the St George's Hotel, Albemarle St. A new club was formed of eight members; viz: Tyndall, Hooker, Huxley, Busk, Frankland, Spencer, Lubbock and myself. Besides personal friendship, the bond that united us was devotion to science, pure and free, untrammelled by religious dogmas. Amongst ourselves there is perfect outspokenness ... the first meeting was very pleasant and "jolly".' For X-Club see, J. Vernon Jensen, 'The X-Club: Fraternity of Victorian Scientists', *British Journal for the History of Science*, 3/17 (1970): 63–72; Roy M. Macleod, 'The X-Club: A Social Network of Science in Late-Victorian England', *Notes and Records of the R.S.*, 24 (1970): 305–23; Ruth Barton, '"An Influential Set of Chaps": The X-Club and Royal Society Politics, 1864–85', *British Journal for the History of Science*, 23 (1990): 53–81; Ruth Barton, 'Huxley, Lubbock, and half a Dozen Others', *Isis*, 89 (1998): 410–44.

47 CUL, Add 5989; Tyndall to Berger, 11 June 1864; no address. Quoted in Brock and Macleod, 'The Scientists' Declaration', p. 52.

48 This may have been the position of George Airy. He wrote to Berger stating that he saw no need for 'such a memorial though he did not object to the terms of it'. CUL, Add 5989; Airy to Berger, 6 August 1864, Royal Greenwich Observatory.

49 Chadwick, *The Victorian Church*, p. 6. See also Geoffrey Cantor, *Michael Faraday: Sandemanian and Scientist: a study of science and religion in the nineteenth century* (Basingstoke: Macmillan, 1991). Many medical men signed the Declaration.

50 James, 'The Sacralisation of Science'. That most scientists were orthodox Christians at this time has been well established by Moore, *The Post-Darwinian Controversies*, pp. 83–4.

51 CUL; Add 5989; G.G. Stokes to Groves, 8 September (no year, or address; probably 1864). Stokes was Lucasian Professor at Cambridge, but had taught also at the Royal School of Mines since the Lucasian chair was not very remunerative.

52 For Herschel and Bowring letters see, *Athenaeum*, 17 September 1864; *The Times*, 20 September 1864. McLeod and his colleagues agreed that their side of the correspondence could be published also.

53 Daubeny also took it on himself to defend Baden Powell, the only scientist among the Essayists. See 'A Few Words of Apology for the late Professor Baden Powell's Essay "On the Study of the Evidences of Christianity", contained in the volume entitled

"Essays and Reviews"'; reprinted in Charles Daubeny, *Miscellanies: being a collection of memoirs and essays on scientific and Literary Subjects, published at various times*, 2 vols (Oxford and London: James Parker, 1867); see preface, vol. 1, p. xvii and vol. 2, p. 25. Daubeny believed that Baden Powell's essay had been misunderstood and wanted, after Powell's death, to 'vindicate a brother Professor from the charge of Infidelity'. (His letter to *The Times* is also reprinted in *Miscellanies*, vol. 2, pp. 129–33.)

54 Elsewhere Daubeny expressed a widely held, but conservative, view: 'to me, it appears, that the establishment of the reality of Miracles is the one thing needful for the maintenance of Christianity. ... If their reality, or even their validity ... be once denied, that of Prophecy would soon follow.' Daubeny, *Miscellanies*, vol. 1, preface, p. xiii.

55 University College, founded as a secular institution, was known in some quarters as 'that Godless institution on Gower Street'.

56 Anonymous (De Morgan), 'Sir John Herschel and the New Test', *Saturday Review*, 24 September 1864, pp. 386–7. As noted above, and clear from his diary, McLeod had accepted Darwinian evolution as basically correct; but he believed evolution to be part of God's design. Later, in 1869, at the Exeter meeting of the British Association, McLeod attended a lecture given by Archdeacon Freeman in which the Darwinian view was opposed. The archdeacon discussed the formation of 'man and animals ... he thought that the cherubim were the types from which the animals were made. It did not seem to me satisfactory.' At the same meeting Dr McCain, DD, gave a paper critical of Huxley. Huxley gave a 'magnificent speech but scarcely answered McCain's'. McLeod also approved the presidential speech given by George Stokes, 'against the rationalists'. IC Archives, McLeod Diary, 18 and 20 August 1869.

57 Fellow logician, George Boole, in a very thoughtful letter, stated his refusal to sign was in part because he did not like influencing the course of events by 'the authority of names' and, further, he believed the exercise to be divisive. CUL; Add 5989; Boole to McLeod, 22 July 1864, Cork.

58 *Athenaeum*, 29 October 1864. McLeod and Berger were making public the names of those who had already signed.

59 CUL, Add 5989; Sedgwick to Groves, 13 February 1865, Cambridge.

60 A. De Morgan, *Athenaeum*, 19 November 1864.

61 CUL, Add 5989; Brewster to McLeod, 29 November 1864.

62 Sir David Brewster (1781–1868). IC Archives; McLeod Diary, 19 January 1865. CUL, Add 5989; Brewster to Berger, 17 April 1865. In her memoir, Brewster's daughter notes the pleasure he took in the Declaration and that he believed there was 'no justice in regarding men of real science as more inclined to infidelity than others'. Margaret M. Gordon, *The Home Life of Sir David Brewster* (Edinburgh: Edmonston and Douglas, 1869), pp. 323–4.

63 IC Archives; McLeod Diary; see, for example, 23, 24 January, 17 March, 8 April 1865. Hofmann paid McLeod £75, plus expenses, for just under four months work.

64 David Brewster advised the young men to change the name of their Declaration from 'The Natural Sciences Declaration' to 'The Declaration of the Cultivators of Natural and Physical Science', which was very close to the title finally chosen. CUL, Add 5989; Brewster to Berger, 17 April 1865.

65 A. De Morgan, *Athenaeum*, 1 July 1865, p. 19. As noted (note 29 above), the Declaration was deposited in the Bodleian Library.

66 It is possible that Sir James Alderson was of help here, though there is no direct evidence. McLeod simply notes Alderson's support in his diary.

67 De Morgan made fun of the fact that Bowerbank signed the Declaration while also subscribing to the Bishop of Natal Defence Fund. *Athenaeum*, 7 January 1865, p. 22.

68 Brock and Macleod, 'The Scientists' Declaration', p. 43.

69 Huxley, quoted in Desmond, *The Devil's Disciple*, p. 251.

70 Hannah Gay, '"Pillars of the College": Assistants at the Royal College of Chemistry, 1846–1871', *Ambix*, 47, part 3 (2000): 135–69.

71 One of the college founders, J. Lloyd Bullock, a chemical manufacturer, signed the Declaration. For the founding of the College, and for its early patrons, Gerrylynn K. Roberts, 'The Establishment of the Royal College of Chemistry: an investigation of the social context of early Victorian chemistry', *Historical Studies of the Physical Sciences,* 7 (1976): 437–85.

72 McLeod and Gillman had worked, under Hofmann, on the preservation of stone monuments within the Abbey. Gay, 'Pillars of the College', p. 149.

73 See note 46, above.

74 IC Archives; McLeod Diary, entries for March 1869. Entries in the early 1870s note McLeod returning the favour by helping Huxley with a number of his experiments.

75 See Hannah Gay, 'Science and Opportunity in London, 1871–85: The Diary of Herbert McLeod', *History of Science*, 41 (2003): 427–58.

76 IC Archives; McLeod Diary, see entries in January and February, 1870. See also, Brendan P. Cuddy, 'The Royal Indian Engineering College, Cooper's Hill (1871–1906): a case study of state involvement in professional engineering', PhD dissertation, Chelsea College, University of London, 1980. (Thesis deposited at Brunel University, Cooper's Hill). Several applicants for the Cooper's Hill position had PhDs. McLeod had no degree but an excellent reputation as a chemical manipulator.

77 IC Archives; McLeod Diary; see, for example, 2 June 1873.

78 Peter J.T. Morris and Colin A. Russell, *Archives of the British Chemical Industry, 1750–1914* (London: British Society for the History of Science, 1988), pp. 103–104.

79 In his later years, McLeod took over the editorship of the Royal Society Catalogue of Scientific Papers.

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Chapter 2

Theological Insights from Charles Darwin[1]

Denis O. Lamoureux

In his acclaimed best-seller *The Blind Watchmaker* (1986), the inimitable Richard Dawkins writes, 'I could not imagine being an atheist before 1859, when Darwin's *Origin of Species* was published. ... Darwin made it possible to be an intellectually fulfilled atheist.'[2] Many people today would agree with Dawkins in suggesting that the father of the theory of biological evolution is the chief apostle of atheism. However, is this actually the case? Or is the association of Darwin with unbelief a popular cultural myth that has been thoughtlessly propagated throughout modern society?

This paper is a brief review of the central religious beliefs of Charles Darwin. In particular, it presents evidence from the primary historical literature dealing with his theological reflections on evolutionary theory. To the surprise of many, Darwin not only contributed to science a brilliant outline of the theory of biological origins, but his thoughts regarding the religious implications of evolution are profound and provide valuable insights to theology.

Charles Darwin was born on 12 February 1809 and raised in a comfortable British setting surrounded by a variety of religious and philosophical beliefs. His physician father Robert was a 'free thinker on religious matters' and at best a 'nominal' Anglican.[3] Darwin's mother Susannah came from a devout Unitarian family and attended church with her children. Regrettably, she died when Charles was only 8 years old. Thereafter, his older sisters assisted in raising him and brought him to Anglican services.[4] Darwin received an education from an Anglican day school, and in his Autobiography refers to religious beliefs that are typical of a child. He writes:

> I remember in the early part of my school life [1818–1825] that I often had to run very quickly to be in time, and from being a fleet runner was generally successful; but when in doubt I prayed earnestly to God to help me, and I well remember that I attributed my success to prayers and not to my quick running, and marvelled how generally I was aided.[5]

As a teenager, Darwin read his grandfather Erasmus's *Zoonomia, or the Laws of Organic Life* (1794-6), a book which presented the notion that God created life through an evolutionary process.[6] Though he notes that it had little effect on him at that time, Darwin later believed that its positive appraisal opened the way for serious consideration of this view of origins.

After a failed attempt at studying medicine in Edinburgh and upon the insistence of his father, Darwin enrolled in theology at Christ's College, Cambridge University, in 1828. His father's intent was not religious, but practical. His son lacked direction and this way he would at least receive an education fitting a proper British gentleman.

There is little evidence to suggest Charles had a passionate faith at that point in his life, though he reveals that 'I did not then in the least doubt the strict literal truth of every word in the Bible.'[7] Darwin completed the divinity programme in 1831 but decided not to be ordained as a minister. Yet, Cambridge gave him a purpose – he fell in love with science. His views on origins were typical of the early nineteenth century. He accepted that the earth was old, though catastrophic events like floods still played a part in geology for understanding surface features. Darwin was also a progressive creationist[8], believing in the immutability (unchangeability) of species, and maintaining that God intervened to create life at different points in geological history.

More specifically, Darwin's view of nature was steeped in the categories of the British naturalist–theologian William Paley. His *Evidences of Christianity* (1794) and *Natural Theology* (1802) were required reading at Cambridge in the early 1800s, and Darwin claimed that studying these works were the only valuable part of his education. Well known for the watchmaker argument[9], Paley argued that the universe features: (1) Intelligent Design[10] – the beauty and complexity of nature ultimately reflect the mind of the Creator, (2) Perfect Adaptation – each and every detail found in the world fits perfectly in its place, and (3) Beneficence – creation is very good. Looking back on his life, Darwin wrote:

> I did not at that time trouble myself about Paley's premises; and taking these on trust I was charmed and convinced by the long line of argumentation. ... I was not able to annul the influence of my former belief, then almost universal, that *each* species had been purposely created; and this led to my tacit assumption that *every detail* of structure, excepting rudiments, was of some special, though unrecognized, service.[11]

It is important to note that Paley's understanding of design is both static and fused to the notion of perfect adaptability. That is, *each* and *every detail* in the world had some specifically designed purpose. Consequently, there was no room for maladapted structures or creatures, including evolving ones, in God's good and perfectly ordered creation.

Darwin boarded HMS *Beagle* with these assumptions about nature on 27 December 1831. He also came with Christian beliefs and recalled:

> Whilst on board the *Beagle* I was quite orthodox, and I remember being heartily laughed at by several of the officers (though themselves orthodox) for quoting the Bible as an unanswerable authority on some moral point. I suppose it was the novelty of the argument that amused them.[12]

More significantly for the development of his science, Darwin boarded with the first volume of Charles Lyell's recently-published *Principles of Geology* which, as part of a three volume series (1830–1833), set down the foundations of modern geology. Soon after arriving in South America, his field experience of the region led him to embrace uniformitarian geology.[13] However, uniformitarianism did not extend to Darwin's biology. Late in the voyage he was still an anti-evolutionist, arguing in a perfect Paleyan fashion, that evolution was 'a supposition in contradiction to the fitness which the Author of Nature has now established'.[14] Nine months before returning to England, Darwin remained a progressive creationist. He writes,

'The one hand has surely worked throughout the universe. A Geologist perhaps would suggest that the periods of Creation have been distinct & remote the one from the other; that the Creator rested in his labour.'[15] In the last entry of the *Beagle Diary*, Darwin's acceptance of intelligent design in nature is obvious:

> Amongst the scenes which are deeply impressed on my mind, none exceed in sublimity the [Brazilian] primeval forests ... [for they] are temples filled with the varied productions of the God of Nature. No one can stand unmoved in these solitudes, without feeling that there is more in man than the mere breath of his body.[16]

Clearly, throughout the famed trip, Darwin believed in a Creator. Not only did nature profoundly impact him by reflecting intelligent design, but Darwin's God intervened to create life at different points in geological history.

Darwin set foot on English soil after his five-year voyage around the world on 2 October 1836. During the next two years he entered his first period of intense theological reflection. As Darwin recalls, 'I was led to think much about religion.'[17] It was also at this time that he formulated the theory of evolution. To be sure, evolutionary theory has significant religious implications and Darwin recognized it. In this period, he rejected his Christian faith. Regarding the Old Testament, he remarks:

> I had gradually come by this time, to see that the Old Testament, from its manifestly false history of the world, with the Tower of Babel, the rainbow as a sign, etc., etc., and from its attributing to God the feelings of a revengeful tyrant, was no more to be trusted than the sacred books of the Hindoos, or any barbarian.[18]

With a growing appreciation for the regularity in the laws of nature, Darwin also dismissed the New Testament and its record of miracles. He argues, 'The more we know of the fixed laws of nature the more incredible do miracles become ... the men at that time were ignorant and credulous to a degree almost incomprehensible by us.'[19] As a result, Darwin concludes, 'I came to disbelieve in Christianity as a divine revelation.'[20]

Though Darwin rejected the personal God of Christianity, he remained a firm believer in a Creator. More specifically, he renounced theism and espoused deism.[21] During the late 1830s, Darwin outlined a theory on the origin of life, including humanity, that did not require the dramatic Divine *interventions* of progressive creation, and based his model on *providential* natural laws.[22] That is, he envisioned God creating through physical processes. Excerpts from his personal scientific notebooks reveal this distinction in God's activity:

> Astronomers might formerly have said that God ordered [i.e., Divine interventionism] each planet to move in its particular destiny – In the same manner God orders each animal with certain form in certain country. But how much more simple & sublime power [to] let attraction act according to certain law; such are inevitable consequences; let animals be created, then by the fixed laws of generation [i.e., Divine providentialism]. ... Man in his arrogance thinks himself a great work worthy of the interposition of a deity [i.e., interventionism], more humble & I believe truer to consider him created from animals [i.e., providentialism].[23]

Darwin at this time began formulating the foundations of evolutionary psychology, and he cast his theory within a theological framework. For example, he argues that a 'philosopher' (that is, natural philosopher, or better 'scientist') errs if he 'says the innate knowledge of creator [is] has been/implanted in us (?individually or in race?) by a separate act of God, & not as a necessary integrant part of his most magnificent laws. which we profane in thinking not capable to produce every effect of every kind which surrounds us.'[24] According to Darwin, not recognizing God's 'sublime power' and the 'inevitable consequences' of the 'magnificent laws' of evolution was to 'profane' the Creator.

Darwin scratched out in his personal notebooks a deistic theory of evolution during the late 1830s, but it would take twenty years before he made his view of origins public, and a dozen more years after that before Victorian England would read that humanity was also created through evolution.[25] In November 1859, *On the Origin of Species* was released. It included seven unapologetic and positive references to the 'Creator.'[26] Staunchly opposed to the 'science-of-the-day' (progressive creation), Darwin defends:

> Authors of the highest eminence seem to be fully satisfied with the view that each species has been independently created. To my mind it accords better with what we know of the laws impressed on matter by the Creator, that the production and extinction of the past and present inhabitants of the world should have been due to secondary causes like those determining the birth and death of the individual.[27]

Darwin's rejection of interventionism and acceptance of providentialism in this passage is clear.[28] God creates life, both in the womb and on the earth, through natural laws that he ordained. In other words, Darwin's view of evolution in the famed 1859 work was *teleological*.[29] This natural process had a goal or final outcome – it had plan and purpose. Darwin did not espouse the popular understanding of evolution (atheistic/dysteleological) seen in modern society today, of a process run by merely chance and irrational necessity.

God's part in the evolutionary process is further seen in the well-known final sentence of the *Origin of Species*:

> There is grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone on cycling according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved.[30]

This passage – appearing in the second edition of the *Origin of Species* the following year, and right up until the sixth and final edition in 1872 – is even more specific. It includes the phrase 'originally breathed by the Creator.'[31] Interestingly, Darwin somehow failed to recognize his own interventionism in the origin of the first few forms or form of life.[32] Moreover, clearly, the evolutionary laws were God's laws, and there is even a hint of their revelatory character in that the world created by evolution has a 'grandeur' since life is 'most beautiful and most wonderful.' It is, then, simply a popular myth that Darwin's *Origin of Species* is necessarily atheistic. For those who have actually read the famed book, such a belief is mere fantasy.[33]

Soon after the publication of the *Origin of Species*, Darwin entered a second period of intense theological reflection. His professional colleagues raised important issues, and he dealt directly with the religious themes of intelligent design in nature, the problem of pain, and Divine sovereignty over the world. Regarding design, Darwin confessed to Harvard botanist Asa Gray (in a series of letters written during 1860):

> This [issue of design] is always painful to me. I am bewildered. *I had no intention to write atheistically*. But I own I cannot see as plainly as others do, and as I should wish to do, evidence of design and beneficence *on all sides of us*. ... On the other hand, I cannot anyhow be contented to view this wonderful universe, and especially the nature of man, and to conclude that everything is the result of brute force. ... I grieve to say that I cannot honestly go as far as you do about Design. I am conscious that I am in an utterly hopeless muddle. I cannot think that the world, as we see it, is the result of chance; and yet I cannot look at *each* separate thing as the result of Design. ... Again, I say I am, and shall ever remain, in a hopeless muddle.[34]

Darwin is clearly not an atheist at this point in his career. Of course, 'evidence of design ... *on all sides of us*' and '*each* separate thing as the result of Design' was William Paley still speaking through him. His muddle, pain and bewilderment over the issue of design can be understood in the light of these categories ingrained in him during his education at Cambridge.

On the one hand, Darwin's theory of evolution undermined Paley's account of static perfection and adaption in each and every corner of the universe. Indeed, the dynamic evolutionary process was by definition incommensurable with the perfectly designed Paleyan world. As Darwin later wrote, 'The old argument of design in Nature, as given by Paley, which formerly seemed to me so conclusive, fails, now that the law of natural selection has been discovered.'[35] Yet on the other hand, Darwin continued to experience nature's beauty and complexity as a scientist and to sense what most people perceive – that there is some sort of teleological reality behind the world, like a God or Supreme Force.[36] In other words, Darwin was trapped between his Paleyan understanding of intelligent design and his experience of design in nature.[37] One wonders why Darwin did not seriously consider a view of intelligent design that was not suffocated by Paley's strict categories of design in each and every detail of the world[38] – but, of course, it is easy to say this in hindsight.

Darwin also dealt with the greatest challenge to theism – the problem of pain. Concisely stated, why would the all-loving and all-powerful God of theism allow suffering in the world? In a letter to Gray he complains:

> But I own I cannot see as plainly as others do, and as I should wish to do, evidence of design and *beneficence* on all sides of us. There seems to me too much misery in the world. I cannot persuade myself that a *beneficent* and omnipotent God would have designedly created the Ichneumonidae with the express intention of their feeding within the bodies of Caterpillars, or that a cat should play with mice.[39]

Again, a Paleyan category of nature is evident in his understanding of religion – beneficence everywhere throughout nature. Most feel the weight of Darwin's complaint. Why would the theistic God allow a wasp (Ichneumonidae) to lay its

eggs in a caterpillar so that, as they develop, they slowly consume the host's internal organs until its death? In an earlier letter to J.D. Hooker, Darwin was even more explicit regarding the lack of beneficence in the living world: 'What a book a Devil's chaplain might write on the clumsy, wasteful, blundering low & horridly cruel works of nature!'[40]

Darwin was also intimately familiar with pain. Shortly after his *Beagle* voyage, he contracted a condition that saw him suffer bouts of nausea, vomiting, dizziness, chest pains and palpitations for the rest of his life.[41] And, as many modern Darwin scholars have speculated, the suffering and eventual death of his beloved ten-year-old daughter Annie in 1850 deeply traumatized him.[42] Indeed, nature was not at all as Paley had envisioned, and it was only late in life that Darwin came to terms with the pain suffered by living creatures.

Finally, during his second intense period of theological reflection, Darwin wrestled with the question of Divine sovereignty over world. In a letter to Charles Lyell, he writes:

> The view that *each* variation has been providentially arranged seems to me to make Natural Selection entirely superfluous, and indeed take the whole case of the appearance of new species out of the range of science. It seems to me that variations in the domestic and wild conditions are due to unknown causes, and are without purpose, and in so far accidental; and that they become purposeful only when they are selected by man for his pleasure, or by what we call Natural Selection in the struggle for life, and under changing conditions. I do not wish to say that God did not foresee everything which would ensue; but here comes very nearly the same sort of wretched imbroglio as between freewill and preordained necessity.[43]

Again, Darwin's argument is steeped in Paley's notion of perfect adaptability. But more significantly, a dysteleological element is clearly developing in his understanding of evolution at this time: biological variations 'are without purpose, and in so far accidental'. However, Darwin does not embrace an entirely dysteleological world view. He remains a deist, affirming the existence of God and his sovereignty over nature and the evolutionary process. His use of Divine foresight to 'baptize' evolutionary theory in this passage reflects theological sophistication.

Many of Darwin's theological notions expressed in private correspondence during this second period of religious reflection eventually appeared in his major scientific books. In the closing pages of *The Variation of Animals and Plants Under Domestication* (1868), he is still being influenced by Paleyan notions of nature, but comes to an uneasy resolution, employing his Divine foresight argument. The final sentences of this scientific work are:

> If we assume that *each particular* variation was from the beginning of all time preordained, then that plasticity of organization, which leads to many injurious deviations of structure, as well as the redundant power of reproduction which inevitably leads to a struggle for existence, and, as a consequence, to the natural selection or survival of fittest, must then appear to us superfluous laws of nature. On the other hand, an omnipotent and omniscient Creator ordains everything and foresees everything. Thus we are brought face to face with a difficulty as insoluble as is that of free will and predestination.[44]

Clearly, Darwin still believed in the existence of a 'Creator' who was both 'omnipotent' and 'omniscient'. However, he struggled with this belief and those features in his evolutionary theory which pointed away from a world created by God, that is, 'injurious deviations', 'redundant reproduction', 'natural selection', and 'survival of the fittest'. Undoubtedly, remnants of Paleyan beneficence still tugged at Darwin's theology.

In *Descent of Man* (1871), Darwin finally put before the eyes of Victorian England his view that humanity was included in his evolutionary theory. As noted previously, human evolution was an integral part of his science from the earliest notebooks in the late 1830s. But Darwin only hinted at it in the famed *Origin of Species*; his only remark on the subject was:

> In the distant future I see open fields for far more important researches. Psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation. Light will be thrown on the origin of man and his history.[45]

Descent of Man offered a comprehensive theory of evolutionary psychology, and it even included an account of the evolution of religious belief.[46] Anticipating criticism from religious individuals, Darwin writes:

> I am aware that the conclusion arrived at in this work will be denounced by some as highly irreligious; but he who denounces them is bound to shew why it is more irreligious to explain the origin of man as a distinct species by descent from some lower form, through the laws of variation and natural selection, than to explain the birth of the individual through the laws of ordinary reproduction. The birth both of the species and of the individual are equally parts of that grand sequence of events, which our minds refuse to accept as the result of blind chance.[47]

Unquestionably, Darwin saw evolutionary psychology as neither atheistic nor dysteleological. For that matter, the preceding passage could be seen as a defence of the existence of the creator of the embryological and evolutionary processes, which together reflect a 'grand' picture of nature.

Darwin's mature theological views appear in his *Autobiography* (1876) in a section entitled 'Religious Belief'. He deals directly with the classic arguments both for and against God's existence, and examines these in the light of evolutionary theory. Beginning with the problem of suffering, Darwin argues:

> A being so powerful and so full of knowledge as a God who could create the universe, is to our finite minds omnipotent and omniscient, and it revolts our understanding to suppose that his benevolence is not unbounded, for what advantage can there be in the suffering of millions of lower animals throughout almost endless time? This very old argument from the existence of suffering against the existence of an intelligent first cause seems to me a strong one.[48]

But interestingly, Darwin is quick to answer this objection. He addresses the issue of suffering by his observation that:

> According to my judgment happiness decidedly prevails [in the natural world] ... all sentient beings have been formed so as to enjoy, as a general rule, happiness ... most sentient beings experience an excess of happiness over misery, although many occasionally suffer much.[49]

For Darwin, this is not the world of Paley, dripping with beneficence, but it nevertheless is a good world. Life would never have evolved if creatures suffered most of the time. The bite of the Ichneumonidae from Darwin's second period of theological reflection seems to have lost its sting if viewed from an evolutionary perspective. According to Darwin, the problem of pain is no longer a conclusive argument against God's existence.

Darwin then turns to two arguments for God's existence; the centrality of intelligent design in each is evident. In the first, Darwin affirms what he calls a 'religious sentiment'. He writes:

> At the present day the most usual argument for the existence of an intelligent God is drawn from the deep inward conviction and feelings which are experienced by most persons. ... Formerly I was led by feelings such as those just referred to, ... to the firm conviction of the existence of God, and of the immortality of the soul. In my Journal I wrote that whilst standing in the midst of the grandeur of a Brazilian forest, 'it is not possible to give an adequate idea of the higher feelings of wonder, admiration, and devotion which fill and elevate the mind'. I well remember my conviction that there is more in man than mere breath of his body.[50]

However, Darwin writes off this experience as merely psychological and claims:

> But now the grandest scenes would not cause any such convictions and feelings to rise in my mind. It may be truly said that I am like a man who has become colour-blind, and the universal belief by men of the existence of redness makes my present loss of perception of not the least value of evidence.[51]

From Darwin's perspective, then, 'religious sentiment' is not an argument for God's existence.

In the second argument for the existence of God in Darwin's *Autobiography* the appreciation for the reflection of intelligent design in nature is more substantive. Darwin writes:

> Another source of conviction in the existence of God, connected with the reason and not with the feelings, impresses me as having much more weight. This follows from the extreme difficulty or rather impossibility of conceiving this immense and wondrous universe, including man with his capacity of looking backwards and far into futurity, as a result of blind chance or necessity. When thus reflecting I feel compelled to look to a First Cause having an intelligent mind in some degree analogous to that of man; and I deserve to be called a Theist.[52]

Sensitive Darwin scholars note the present tense of the verb 'feel' in the final sentence of this passage.[53] That is, in 1876, late in his life, Darwin feels compelled to look for a First Cause with an intelligent mind, and he even says that he deserves to be called a 'Theist'.[54] But like all the other arguments dealing with God's existence, Darwin

has a rebuttal. He claims that though his belief in intelligent design was 'strong' at the time he wrote the *Origin of Species*, it 'has very gradually with many fluctuations become weaker'.[55] In particular, Darwin is deeply troubled with this belief because 'the horrid doubt' arises, 'Can the mind of man, which has, as I fully believe, been developed from a mind as low as that possessed by the lowest animal, be trusted when it draws such grand conclusions?'[56] According to Darwin, this powerful rational argument for God's existence is not trustworthy.

The conclusion Darwin draws in 'Religious Belief' is that arguments either for or against the existence of God ultimately fall short. He then confesses, 'I cannot pretend to throw light on such abstruse problems. The mystery of the beginning of all things is insoluble by us; and I for one must be content to remain an Agnostic.'[57]

Darwin's agnosticism and fluctuating theological beliefs also appear during the last years of his life. In a letter addressed to James Fordyce in 1879 regarding his beliefs, he writes:

> What my own [religious] views may be is a question of no consequence to any one but myself. But, as you asked, I may state that my judgment often fluctuates. ... In my most extreme fluctuations *I have never been an Atheist* in the sense of denying the existence of a God. I think that generally (and more and more as I grow older), but not always, that an Agnostic would be the more correct description of my state of mind.[58]

It is important to note that this letter was written two years before Darwin's death in 1882, and he is stating quite explicitly that he has 'never been an Atheist'. Indeed, there is no evidence that, throughout his professional career, Darwin ever embraced an atheistic or dysteleological view of biological evolution. Moreover, if Darwin had 'never been an Atheist' and 'generally, but not always' an agnostic, then there must have been times when he was a 'theist' – as he had earlier acknowledged in the *Autobiography*.

Finally, in the last year of Darwin's life in 1882, the Duke of Argyll raised with him the issue of intelligent design in nature. Writing about this conversation, he recalls:

> I said to Dr. Darwin, with reference to some of his own remarkable works on the 'Fertilization of Orchids' and upon 'The Earthworms', and various other observations he made of the wonderful contrivances for certain purposes in nature – I said it was impossible to look at these without seeing that they were the effect and the expression of mind. I shall never forget Mr. Darwin's answer. He looked at me very hard and said, 'Well, that often comes over me with overwhelming force; but at other times,' and he shook his head vaguely, adding, 'it seems to go away.'[59]

This is an fascinating passage – especially for one who only six years earlier in his *Autobiography* claimed to have become 'colour-blind' to the revelatory message in nature, writing that 'the grandest scenes would not cause any such convictions and feelings to rise in [his] mind.' Undoubtedly, the impact of 'the expression of mind' seen in nature served as a source fuelling Darwin's 'not always' belief in a God.

The historical record, then, clearly reveals that Charles Darwin was never an atheist. Throughout his career, the father of modern evolutionary theory gave

serious consideration to the religious implications of his science. For that matter, he often integrated these beliefs into his evolutionary theory, as seen in his scientific notebooks, private correspondence and professional publications. Darwin offers valuable theological insights worth examination regarding intelligent design reflected in nature, the problem of pain, and Divine sovereignty over the world.

Notes

1 An earlier version of this paper appeared in *Perspectives on Science and Christian Faith*, 56 (2004): 2–12. I am grateful for the permission of the editor to use this material here.

2 Richard Dawkins, *The Blind Watchmaker* (London: Penguin Books, 1991 [1986]), pp. 5–6.

3 Charles Darwin, *The Life and Letters of Charles Darwin*, Francis Darwin (ed.), 3 vols (London: John Murray, 1888), vol. 2, p. 178.

4 Charles Darwin, *The Autobiography of Charles Darwin, 1809–1882*, Nora Barlow (ed.) (London: Collins, 1958), p. 22.

5 Darwin, *Autobiography*, p. 25.

6 Darwin, *Autobiography*, p. 49.

7 Darwin, *Autobiography*, p. 57.

8 The term 'creationist' carries a variety of nuances and requires qualification. *Young Earth Creation* is popular understanding of the creationist position. It rejects all the modern sciences dealing with origins and suggests that the world was created in six literal days less than 10,000 years ago and that all of geological stratification was the result of Noah's global flood. *Progressive Creation* (or Old Earth Creation) accepts the standard geological dating of the earth (4.6 billion years), but rejects biological evolution maintaining that God created life in stages over the eons of time. *Evolutionary Creation* (or Theistic Evolution) asserts that the personal God of the Bible created the universe and life through evolutionary processes. *Deistic Evolution* (also Theistic Evolution) has an impersonal God begin the evolutionary process and never enter the universe thereafter. *Dysteleological Evolution* (or Atheistic Evolution) is the popular understanding of the evolutionist position. It rejects the existence of God and believes that the world evolved entirely by chance and irrational necessity.

9 Concisely stated, Paley argued that if a watch is found in a field, then it is logical to conclude the existence of a watchmaker. So too with nature. Complexity, contrivance and design in the world point to a Creator with a purpose. See William Paley, *Natural Theology*, in Robert Lynam (ed.), *The Works of William Paley*, 6 vols (Edinburgh: Baynes and Son, 1825), vol. 4, pp. 1–12.

10 The notion of 'intelligent design' has gained much attention in recent years due to the so-called 'Intelligent Design Movement'. However, it is important to distinguish this modern understanding of design from the traditional position. For intelligent design theorists like Phillip Johnson, Michael Behe and William Dembski, design is associated with biological structures (termed 'irreducibly

complex') that purportedly could not evolve by natural processes. However, the traditional interpretation of design focuses on the beauty and complexity in nature and does not deal with the mechanisms by which these features arose. The historical view of design simply acknowledges that the world powerfully impacts most everyone into believing that it reflects the mind of an Intelligent Being.

11 Darwin, *Autobiography*, p. 59; Charles Darwin, *The Descent of Man and Selection in Relation to Sex*, New Edition, Revised and Augmented (New York: D. Appleton, 1886 [1871]), p. 62. My italics.

12 Darwin, *Autobiography*, p. 85.

13 Darwin writes, 'I am proud to remember that the first place, namely, St Jago, in the Cape Verde Archipelago, which I geologised, convinced me of the infinite superiority of Lyell's view over those advocated in any other work known to me.' Darwin, *Autobiography*, p. 101.

14 Quoted in Sandra Herbert, 'The Place of Man in the Development of Darwin's Theory of Transmutation', *Journal of the History of Biology*, 7 (1974): 233 note 50. Darwin MSS, vol. 42, ULC (Feb 1835).

15 Charles Darwin, *Diary of the Voyage of H.M.S. Beagle*, Nora Barlow (ed.), vol. 1 in *The Works of Charles Darwin*, Paul H. Barrett and R.B. Freeman (eds), 29 vols (London: William Pickering, 1986), vol. 1, p. 348. (18 January 1836).

16 *Diary*, vol. 1, p. 388. (24 September 1836).

17 Darwin, *Autobiography*, p. 85.

18 Darwin, *Autobiography*, p. 85. Interestingly (or ironically!), this passage reveals that Darwin was a strict biblical literalist, similar to today's Christian fundamentalists.

19 Darwin, *Autobiography*, p. 86.

20 Darwin, *Autobiography*, p. 86.

21 According to *theism*, God is all-loving and all-powerful. He is personally involved in the lives of people and answers their prayers in miraculous ways. On the other hand, *deism* states that God is impersonal and never enters the universe, having little to do with humanity. It is important to note that 40 per cent of first-rate American scientists are theists. See Edward J. Larson and Larry Witham, 'Scientists Are Still Keeping the Faith', *Nature*, 386 (3 April 1997): 435–6.

22 An important theological distinction needs to be made regarding Divine action. *Interventionism* is dramatic supernatural activity. For example, prior to the acceptance of Copernicus' view of astronomy, many believed that God moved planets off their normal west-to-east courses causing them to make short east-to-west loops (known as 'retrograde motion'). Darwin refers to this type of Divine action in the next passage. *Providentialism* is God's subtle activity. An example would be the Creator employing natural laws to create life. This is the type of Divine activity Darwin envisioned during the years he formulated his evolutionary theory, and it was clearly included in his famed *Origin of Species*. In the light of this categorical distinction regarding Divine action, a well-known comment by Darwin can be better understood. One of the first people he revealed his evolutionary views to was J.D. Hooker in 1844.

In a letter Darwin writes, 'I am almost convinced (quite contrary to the opinion I started with [i.e., progressive creation]) that species are not (it is like confessing a murder) immutable.' Darwin to Hooker (11 January 1844) in Francis Darwin (ed.), *More Life and Letters of Charles Darwin*, 2 vols (London: John Murray, 1888), vol. 1, pp. 40–41. Also found in Frederick Burkhardt and Sidney Smith (eds), *The Correspondence of Charles Darwin*, 11 vols (Cambridge: University Press, 1987 [1985–1999]), vol. 3, p. 2. Some skeptics argue that this is evidence for Darwin's atheism in that God is the murdered victim. However, qualification is necessary. If it was Darwin's intention in this letter to confess to his murdering God with the theory of evolution (and that can be debated), then it is important to underline that it was the theistic and *interventionistic* God of progressive creation whom he slew. As this paper will further reveal, Darwin firmly believed in a deistic and *providentialistic* God during this early part of his career.

23 Charles Darwin, 'B Notebook (February 1837 to January 1838)', in Gavin de Beer (ed.), 'Darwin's Notebooks on Transmutation of Species', *Bulletin of the British Museum (Natural History)*, 2 (1960): 101 and 106. Note that excerpts from the notebooks are exactly that – rough notes that are not grammatically sound or stylistically proper. In this paper they will be presented as they appeared originally with words occasionally added in brackets [ ] to make the passage more accessible.

24 Charles Darwin, 'M Notebook (July 1838 to October 1838),' in Howard E. Gruber, *Darwin on Man: A Psychological Study of Scientific Creativity Together with Darwin's Early and Unpublished Notebooks*, Paul H. Barrett, transcriber and ed., (New York: Dutton & Co., 1974), p. 292. (# 136).

25 For the sake of brevity, I will not examine the numerous theological passages that Darwin composed in the years between his early notebooks (late 1830s) and the *Origin of Species* (1859). During this period he began with unpublished and private synopses of his theory, 'Sketch' (1842; 35 pages) and 'Essay' (1844; 213 pages), and later started a major work, 'Big Species Book' (1856–1858) known today as *Natural Selection*, which was abbreviated to become the famed *Origin of Species*. The religious beliefs expressed in these works are in principle outlined in the notebooks and then repeated (sometimes almost verbatim) in the *Origin of Species*. See Charles Darwin, *Foundations of the Origin of Species: Two Essays Written in 1842 and 1844*, Francis Darwin (ed.) (Cambridge: University Press, 1909), pp. xxviii, 51–2, 253–5; Charles Darwin, *Charles Darwin's Natural Selection; Being the Second Part of His Big Species Book Written from 1856 to 1858*, R.C. Stauffer (ed.) (London: Cambridge University Press, 1975), pp. 224–5.

26 See Charles R. Darwin, *On the Origin of Species. A Facsimile of the First Edition* (1859), introduced by Ernst Mayr (Cambridge: Harvard University Press, 1964), pp. 186, 188, 189, 413 (twice), 435, 488.

27 Darwin, *Origin of Species*, p. 488. In Darwin's 'Big Species Book', he adds, 'By nature, I mean the laws ordained by God to govern the universe.' Darwin, *Natural Selection*, p. 224.

28 An epigraph in the *Origin of Species* (taken from William Whewell's *Bridgewater Treatise*) depicts Darwin's rejection of interventionism: 'But with regard to the

material world, we can at least go so far as this – we can perceive that events are brought about not by insulated interpositions of Divine power, exerted in each particular case, but by the establishment of general laws.'

29 For the etymology of the term, see *Liddell and Scott Greek–English Lexicon* (Chicago: Follett Publishers, 1954), p. 697; W.F. Arndt and F.W. Gingrich, *A Greek–English Lexicon of the New Testament and Other Early Christian Literature* (Chicago: University Press, 1979), p. 811.

30 Darwin, *Origin of Species*, p. 490.

31 Morse Peckham (ed.), *'The Origin of Species' by Charles Darwin: A Variorum Text* (Philadelphia: University of Pennsylvania, 1959), p. 759.

32 Similar to the *Origin of Species* (1859), Michael Behe's *Darwin's Black Box* proposes that the 'irreducible structures' of the cell were put together 'in one fell swoop' in a 'first cell' from which all life evolved. See Michael J. Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution* (New York: Free Press, 1996), pp. 39, 227–8. Also see my response to a paper by Behe, 'A Box or a Black Hole? A Response to Michael J. Behe', *Canadian Catholic Review* (July 1999): 67–73.

33 Critics of this view claim that in the *Origin of Species* Darwin was simply hiding his true beliefs in order to have his book accepted. A letter to J.D. Hooker is often cited to defend this position: 'I have long regretted that I truckled to public opinion, and used the Pentateuchal term of creation, by which I really meant 'appeared' by some wholly unknown process.' Darwin to J.D. Hooker (29 March 1863) in Darwin, *Life and Letters*, vol. 3, p. 18; *Correspondence*, vol. 11, p. 278. However, if this is the case, then Darwin's regret is short-lived. In the three editions of the *Origin of Species* (1866, 1869, 1872) following this letter to Hooker, he made no effort to remove the 'Pentateuchal term of creation' from his work. But more importantly, a review of Darwin's *personal* scientific notebooks, which were never intended to be public, reveal his theological views are the same as those expressed in the *Origin of Species*. See note 25 above.

34 Darwin to Gray (22 May 1860). Darwin, *Life and Letters*, vol. 2, pp. 311–12; *Correspondence*, vol. 8, p. 224. Darwin to Gray (26 Nov 1860) Darwin, *Life and Letters*, vol. 2, pp. 353–4; *Correspondence*, vol. 8, p. 496. My italics.

35 Darwin, *Autobiography*, p. 87.

36 Interestingly, even Richard Dawkins states, 'The complexity of living organisms is matched by the elegant efficiency of the apparent design. If anyone doesn't agree that this amount of complex design cries out for an explanation, I give up. ... Our world is dominated by feats of engineering and works of art. We are entirely accustomed to the idea that complex elegance is an indicator of premeditated, crafted design. This is probably the most powerful reason for the belief, *held by the vast majority of people that have ever lived, in some kind of supernatural deity*.' *Blind Watchmaker*, pp. xiii, xvi. My italics. Furthermore, a 1996 Princeton University study of the beliefs of Americans reveals that 96 per cent accept the existence of 'a God or universal spirit'. See 'Religion Index Hits Ten-Year High', *Emerging Trends: Journal of the Princeton Religion Research Center* (March 1996), p. 4. Also see Darwin's comment cited in note 50 below.

37 This categorical entrapment in Paleyan categories and the frustration it produced for Darwin is further seen in a letter to J.D. Hooker nearly ten years later: 'My theology is a simple muddle; I cannot look at the universe as the result of blind chance, yet I can see no evidence of beneficent design, or indeed of *design of any kind, in the details*. As for *each* variation that has ever occurred having been preordained for a special end, I can no more believe in it than that the spot on which *each* drop of rain falls has been specially ordained.' Darwin to Hooker (12 July 1870). Darwin, *More Life and Letters*, vol. 1, p. 321. My italics.

38 Darwin considered this view of design in his correspondence with Asa Gray: 'I am inclined to look at everything as resulting from designed laws, with the details, whether good or bad, left to the working out of what we may call chance. Not that this notion *at all* satisfies me.' Darwin, *Life and Letters*, vol. 2, pp. 311–12; *Correspondence*, vol. 8, p. 224. Regrettably, Darwin never develops the notion, nor does he explain why it never satisfied him.

39 Darwin to Gray (22 May 1860), Darwin, *Life and Letters*, vol. 2, pp. 311–12; *Correspondence*, vol. 8, p. 224 [my emphasis].

40 Darwin to Hooker (13 July 1856), Darwin, *More Life and Letters*, vol. 1, p. 94; *Correspondence*, vol. 6, p. 178.

41 For a concise review of Darwin's medical condition and possible diagnosis see Lybi Ma, 'On the Origin of Darwin's Ills', *Discover* (September 1997), p. 27.

42 See James R. Moore, 'Of Love and Death: Why Darwin "Gave Up Christianity"' in his *History, Humanity, and Evolution: Essays for John C. Greene* (Cambridge: Cambridge University Press, 1979), pp. 195–229.

43 Darwin to Lyell (2 August 1861). Darwin, *More Life and Letters*, vol. 1, pp. 191–2; *Correspondence*, vol. 9, p. 226. My italics.

44 Charles Darwin, *The Variation of Animals and Plants Under Domestication* (London: John Murray, 1888 (1868)), vol. 2, p. 428. My italics. Darwin seems to have abandoned his Divine sovereignty argument. First evidence of this appears in a letter two years later to J.D. Hooker where he writes: 'Your conclusion that all speculation about preordination is idle waste of time is the only wise one; but how difficult not to speculate!' Darwin to Hooker (12 July 1870). Darwin, *More Life and Letters*, vol. 1, p. 321. Moreover, this argument does not appear in Darwin's mature theological position found in his *Autobiography* (1876).

45 Darwin, *Origin of Species*, p. 488.

46 See the section entitled 'Belief in God – Religion' in Darwin, *Descent of Man*, pp. 93–6.

47 Darwin, *Descent of Man*, p. 613.

48 Darwin, *Autobiography*, p. 90.

49 Darwin, *Autobiography*, pp. 88, 89–90.

50 Darwin, *Autobiography*, pp. 90–91. Darwin is referring to the passage in his *Beagle Diary*. See the quotation referred to in note 16 above. Darwin's comment that this 'religious sentiment' is 'experienced by most persons' complements the view expressed in note 36 above.

51 Darwin, *Autobiography*, pp. 91. Darwin's 'colour-blindness' seems to be somewhat temporary or intermittent as the quotation referred to in note 58 will reveal.

52 Darwin, *Autobiography*, pp. 91–2.
53 See Frank Burch Brown, 'The Evolution of Darwin's Theism', *Journal of the History of Biology*, 19 (1986): 28. Brown argues cogently that Darwin's statement should not be understood as simply a reminiscence.
54 The question arises as to whether Darwin incorrectly uses the term 'theist' in this passage when in fact he means 'deist'. In defence that he does employ the term properly is the following assertion three pages earlier in this section on 'Religious Belief'. Darwin states, 'I did not think much about the existence of a *personal* God until a considerably later period of my life.' Darwin, *Autobiography*, p. 87. My italics.
55 Darwin, *Autobiography*, p. 93.
56 Darwin, *Autobiography*, p. 93. As an aside, one must ask, 'Is Darwin not using a mind 'evolved from lower forms' to make this argument?' There seems to be a problem here with self-referential incoherence.
57 Darwin, *Autobiography*, p. 94.
58 Darwin to Fordyce (1879). Darwin, *Life and Letters*, vol. 1, p. 304. Italics added.
59 Darwin, *Life and Letters*, vol. 1, p. 316.

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Chapter 3

A Model of Interaction Between Science and Theology Based on the Scientific Papers of Pierre Teilhard de Chardin

Lodovico Galleni and Marie-Claire Groessens-Van Dyck

Introduction

Science and Faith – or, better, Science and Theology – have confronted each other from time to time throughout history, and with varying results: exchange, debate, collision, co-operation, competition, integration, and indifference. At the beginning of a third millennium, however, when we see a massive assault on nature and the serious risks to the Biosphere and to humanity, there needs to be a synthesis. Science and Theology need to follow a common path if there is to be a future for both the Noosphere and the Biosphere. By 'Biosphere', we mean the living 'tissue' which covers all the earth, considered as a unit; a similar term – the Noosphere – may be used to refer to the thinking 'tissue' which covers the earth as well.[1] Using these terms, and not those of 'living beings' and 'humankind', involves taking a philosophical stance. Nevertheless, in this way – and thanks to the insights found in the works of Pierre Teilhard de Chardin (1881–1955) – we can develop a global approach both to living beings and to humankind.

A Short Review of the Interactions

An early instance of interaction is reported in the book of Genesis.[2] The biblical author used information from the science of his time and so it is possible to draw from the text some reliable conclusions about the state of biological knowledge of the period. To begin with, living beings are presented by God to Adam in order to receive a name. This clearly suggests that a concept of species had been developed. The biological science of the time, still related to an agro-pastoral culture, was yet able to ascertain that the living beings could be divided into groups defined by their peculiar characteristics, so that it was possible to give them a name. A later redaction of the text (that is, the redaction during or just after the contact with the more advanced culture of the Babylonians) presents a more sophisticated model of species, where living beings were understood to have been created with their own 'seeds': thanks to reproduction, the characteristics which defined the species remained constant over time.[3]

What we have in this instance, then, is an example of interaction: the biblical writers used the science of their time to express a message from God – that is, a theological message. Science is used for theological purposes.

Another instance of interaction can be discerned in classical Greek philosophical and theological thinking. Here, nature was seen as fundamentally rational: the mathematical precision of the movements of the heavens, the apparently definitive knowledge which can be obtained by using mathematical and logical instruments, the adaptation of living beings to their environments. And it was claimed that these aspects of reality can be seriously investigated only if they are the product of a design which came from an intelligent mind; for instance, the Demiurge referred to in the Platonic dialogue, *Timaeus*, is the warrant of the geometrical precision of the universe and of living adaptations. Galen referred to the Demiurge and to his perfect design of the universe in order to provide a rational explication of the structure and function of living beings.[4] The divinity is the warrant of the possibility of this rational investigation. Theology and philosophy, then, provided ideas that gave the natural sciences a way to investigate nature and the rational processes of knowledge; theology is at the service of natural science.

Of course, the interaction of philosophy, theology and natural science takes place within the human mind. Here, we understand these different fields as human constructions – and thus a harmonic synthesis of them all becomes possible. But problems arose when this construction came into contact with religions based on a revelation – that is, a revelation given directly by God and recorded in a text or book (for example, the Bible or the Koran). In this case, we have two different kinds of human inquiry: one is about divinity and its teaching and laws, and is based mainly on the study and interpretation of a text; the other is the autonomous knowledge of science.

The rediscovery of classical science in the Arab world showed the high degree of usefulness and reliability of the instruments of knowledge of Greek logic and mathematics. The knowledge derived from mathematical theorems and from logic looks as absolute and definitive as divine revelation. But what happens if there seems to be a contradiction between revelation and science? The solution proposed by Abu'l Walid Muhammad Ibn Ahmad Ibn Rushd (Averroes, in the Latin tradition), who held that these different ways of knowledge cannot be in contradiction, is of particular interest here.[5] If a contradiction seems to be present, Averroes held, there must be a mistake in the interpretation of the sacred book; sacred books are not to be read literally, but have to be interpreted in an allegorical way. In this way, the unity of knowledge is preserved, but this also illustrates a model of interaction where the knowledge coming from mathematics, logic and natural philosophy is so strong that it is reasonable to ask for a different interpretation of the holy text.

This latter approach was adopted throughout the western tradition. As a starting point for the modern approach to science and theology, we might consider Galileo and his so-called 'Copernican Letters'. (These letters were written in Italian and were addressed to some of his friends and colleagues at the University of Pisa, and to Christina of Lorena, the Grand Duchess of Tuscany.[6]) The Copernican letters were used by Galileo to state clearly the correct relationship between science and theology. They deal explicitly with the astronomical evidence for the Copernican system, but they also present a way of presenting science and biblical revelation to avoid (further) conflict.

We can summarize the main points of Galileo's approach as follows: the Bible tells us how to go to heaven, but not how the heavens go. There are two instruments that enable us to know God's projects and God's will: that based on the 'book' of revelation and that based on the 'book' of nature. But the book of revelation is written in a language adapted to the people who received directly the revelation, whereas the book of nature is written directly in a more general language – that of geometry and mathematics.

So now we have a separation between the 'books', and each 'book' has it own task. Nevertheless, the book of nature – written in more general language – is necessary to the understanding of the book of revelation. (This is, we would maintain, a correct approach and provides a guideline for future discussions of the relationship between the two.) The relationship between the two, then, is asymmetrical. While the description of nature proposed by science is necessary for a correct interpretation of the Bible, science does not consider what we might call the needs of theology. Moreover, there is another risk in Galileo's approach. God is the warrant of the (mathematical) rationality of nature. Mathematics becomes *the* way to understand the intelligibility of nature, and the only way to understand 'the real' on the side of science is through 'measurement'. Now, the cognitive character of theology is based on concepts which are *not* measurable. In this situation, where the method of science seems to be the only one which has true cognitive value, it is difficult to find a synthesis, and theology is progressively restricted to the fields of metaphysics and eschatology. Its value in providing knowledge of nature is reduced, if not altogether denied. And as knowledge of nature came to be seen as the only real knowledge, theology was put into a secondary position and became increasingly neglected.[7]

Fortunately, this extreme result is not inevitable, and we can propose a different synthesis.

Contemporary epistemologists note that a scientific theory is based not only on the results of experiments and observation, but also on a central core, where a 'metaphysical' network is present. Moreover, present-day discussion on complexity has put strong limits on the possibility of measuring and predictability. Most of western science is now open to a different approach, where the relation between science and theology can be presented using a different model of interaction.

This model is derived from the approach to epistemological investigation found in the work of Imre Lakatos.[8] On this model, the knowledge capacities of science are developed thanks to what Lakatos called a 'scientific research program'. This research programme is organized around a central core which is partially constituted by the observations and results of the experiments which allow the formulation of new research programmes. But it also uses ideas not directly based on experience – for example, from one's metaphysical presuppositions or background. Of course, this scientific research programme deals with the results of experiments and observations. But in the construction of the central core, some of the contributions of theology can be recovered and, therefore, can be used to organize a research programme which can be tested experimentally.

In the opinion of the writers of this paper, such a research programme was undertaken by Teilhard de Chardin.

Teilhard wrote a good deal and, apart from materials intended for publication (many of which were published posthumously), he left many letters as well as a *Journal*. A large part of his work has been collected in books and published in articles, and an enormous number of papers and books concerning Teilhard de Chardin have also been published.

Yet in spite of the breadth of this material, many still have only an incomplete view of his activity as a scientist. Teilhard is known around the world for his attempt to construct a synthesis of evolution and Christian theology, as well as for his ideas on the past, present and future of humanity. But he was primarily a scientist, devoted to the fields of geology, palaeontology and palaeoanthropology.

The results of his scientific work have been discussed in books written by L. Barjon and P. Leroy, and by J. Piveteau[9]; his scientific papers have been collected and reprinted by Nicole and Karl Schmitz Moormann.[10] Piveteau speaks of Teilhard as the scientist who gave a new impetus to French palaeontology: 'After 1920, thanks to Teilhard, French paleontology involving the study of mammals found a very distinguished place.'[11] Teilhard is also considered to be the founder of modern Chinese vertebrate palaeontology, but he made a significant contribution as well to Chinese geology and to the study of the culture of fossil man in China.[12]

But what is not yet well known is that Teilhard situated this research within a broad understanding of evolution, taking biology as the science which studies the infinitely complex. He anticipated the contemporary debate on complexity; he proposed a new way to see evolution – that is, to see the Biosphere as an evolving whole – and, in doing so, he provided the building blocks for a new science – Geobiology, the science of continental evolution. For Teilhard, continental evolution was the only way to study, on a relatively small scale but without distortion, how the Biosphere is evolving.

This insight came from his Chinese experience. By examining the evolution of life on a continental level, one could find parallelisms and canalizations[13] which might be overlooked in a larger population. But these kinds of evolutionary mechanism were typical when evolution was analysed on a large scale – that is, that of the Biosphere considered as an evolving complex object. Teilhard may be considered, then, together with the Soviet geochemist Vladimir Vernadsky, as among the founders of the modern science of the Biosphere, and also as one of the forerunners of the present-day science of complexity.[14]

Teilhard's scientific approach, however, is clearly linked to his religious background.

The Formulation of Teilhard's Scientific Research Programme

To begin with, in Teilhard's works, we see clearly that the Universe is undergoing change over time. This change is neither reversible nor cyclic. This change over time is Evolution – of matter, of life, of animals, of humankind, and of the whole Universe.

Evolution is one of the new ideas characteristic of the modern world, and it is one that has been seen to challenge the Christian religion. In his diary, Teilhard links his vocation to that of Cardinal Newman. He writes:

> The more that I read Newman, the more I feel a relationship (however humble, no doubt!) between his spirit and my own. And one result of this resonance is the encouragement that his example gives to me, to carry out *'my'* work. Even here, in this shack in Avocourt, where the shells lie in wait for the poor passers-by, I feel my heart which swells up *in the great hope of the things to be achieved* tomorrow, after the war ... – Yes *I would like to reconcile with God the good that there is in* the modern World, its scientific intuitions, its social thirsts, its legitimate criticisms. On the one hand, I see the natural Universe, changing itself in a *sacred* development, while, on the other hand, I perceive God penetrating and saturating all *natural* energy ... The *New Earth is coming to be, everywhere*. Around the perfected centre that is Christ's Humanity (and that of his Mother) the *Nebula is in the process of dispersion* and concentration, its elements being everywhere, although everywhere they are still mixed and diffuse, certainly separable in their future (much more than in their present: the weeds are not yet distinguished adequately from the good seed). Here is Reality ... But instead of that, the World in Progress and the evolving Church are unaware of one another, mistrust one another; they hurl claims which, actually, do not exist on the same plain, and whose shock is a sophism. Jesus, use me *to put an end to this misunderstanding*, or rather, let me serve this beautiful Cause through the sacrifice of my life. [Emphasis in original.][15]

For Teilhard, who was just beginning his palaeontological research, evolution was among the main 'intuitions scientifiques' of the modern world.

But Teilhard makes another comment of great interest:

> The adoption of the evolutionary model to explain the formation of the World entails a certain way of coming to be 'in the absence of any prior subject matter', and implies that there is a deep *ontological reason* for this world. [16]

Evolution implies a peculiar form of the creative act – a form which has to be seriously taken into consideration by theology. Of course, in expressing things in this way we are still working inside the Galilean model (that is, working under the assumption that the new ideas, coming from the description and interpretation of nature derived from the cognitive enterprise of science, must be taken into consideration by theology). But there is something else in these remarks, and here the distinctiveness of Teilhard's approach comes out. Evolution cannot be just randomness and arbitrariness without any plan; theology requires that there be some necessity within evolution for the emergence of humanity or – to use the term coined by Teilhard, together with Vladimir Vernadsky and Edouard Le Roy – of the Noosphere.[17]

Evolution is not simply a moving without any specific direction, based on the law of change alone. Evolution has to be a *moving towards* – of matter towards complexity and life, of life towards cerebralization, and of cerebralization towards the Noosphere. The biblical value of *moving towards* as a *moving towards* of humanity towards covenant, salvation, and redemption is thus placed inside the general movement of Evolution. (It is interesting that the first modern scientific theory of evolution – that of Lamarck – was linked to a *philosophical* value, the value of enlightenment and of a *moving towards* or progress, which became the metaphysical basis of Lamarck's evolutionary theory.[18]) In Teilhard's account, this *moving towards* became the basis of an experimental research programme: to look at the evolution of animals for parallelisms and canalizations, the principle of which is

related to the increasing size of the brain.[19] These canalizations and parallelisms are considered characteristic of evolutionary mechanisms and are discovered through the experimental inquiries of palaeontology.

Teilhard's research programme required the geologist and the palaeontologist to adopt a new approach and attitude. During the First World War, Teilhard had an exchange of letters with Jean Boussac, who was Professor of Geology at the Institut Catholique de Paris. Among the many issues they discussed was the necessity of taking a different approach to geology – a global approach. But the global approach required adopting a different feeling, and it is curious and remarkable that, from a professor of geology, came the suggestion that the priest read the pages of a mystic, Angela da Foligno.[20]

Boussac wrote:

> My dear Father, how much more do I love you as a scholar than as a warrior! Here, I empathize completely with you, and this unity of object [of purpose and end], that you wish to assign to our double life as Christians and naturalists, seems to me to be an idea that is profoundly true. But I must admit that I have only rarely encountered such a preoccupation in my colleagues from the Sorbonne; as they are generally non-believers, such a preoccupation cannot exist. And the majority of Catholic scholars completely separate their scientific work from their religious life. My father-in-law is the only man in whom I believe I have seen a similar inclination, and I very much believe that what one has called 'geopoetry' is nothing other than the reflection, in his style and in his work, of this 'unformulated' tendency.
>
> As for the rest, this unitive conception [or conception of the unity] of science and Christianity seems to me to be able to come to be first only in the mind of a geologist – that is, of an expert who is used to reflecting on nature as a whole, studying both the Earth and all that operates there, and thus having a more complete and richer view of Creation than, for example, a chemist might have.[21]

And then Boussac quotes Angela da Foligno:

> You remember that vision of the Blessed Angela da Foligno, where God placed the whole world before her and gave her a grasp of both the whole and all its parts, and where the Saint exclaimed 'But this Universe is filled with God, it is filled with God'. On the day that our science is sufficiently comprehensive, knowledge and adoration will be combined with one another in the same act, and it is in this way that the desired unity will happen. The complete realization [or achievement] of this will take place only in the next world, but one can at least make ready for it in this life. [22]

And, interestingly, Teilhard refers to Angela da Foligno in his *Journal* entry for 5 October 1916.[23]

Here we can see that the decision to move beyond the reductionist approach to nature is strictly linked to a global vision that seeks to unify science and religion, and that geology is considered to be the science best suited to do this. But the impetus for this new vision originated with the global approach of a mystic!

Unfortunately this exchange with Boussac soon came to an end; Boussac was killed during the war that he had so strongly condemned.

After the war, Teilhard returned to the Institut de paléontologie humaine in Paris, where he worked with Marcellin Boule. From the purely experimental side, his work focused on the evolution of certain groups of mammals. But one of the main characteristics of his scientific research programme also emerges in this work.

From a theological point of view, there is a necessity that humanity emerge within evolution. But this necessity also has to leave traces which can be discovered through palaeontological investigation. The main objective of Teilhard's work, then, was to look for canalization and parallelisms. The main canalization is that towards the increase in the size of the brain, and the main parallelism is that of an evolution of separated branches towards cerebralization. After completing his doctoral thesis, Teilhard noted some of these aspects in a paper on the evolution of Tarsidae, a type of primitive monkey. Teilhard wrote:

> The number of harmonies in their similarities and differences lead one to believe that Pseudoloris (whose name should really be Protarsius or Tarsiculus) in fact belong to the same group that the Tarsiers come from. Concerning the development of the skull among the Anaptomorphi, after the Pseudoloris and the giant Pseudoloris, Tarsius has, in a way, a symmetrical place to that which Man has among the anthropoids.[24]

And he concluded that:

> Either as a result of some natural superiority, or more simply by chance, the simplification of the group, initially dense, of Tarsiers, took place – and its largest persistence was obtained – on the line leading to the largest brain. A progressive increase in the brain-pan, here then we see the feature which dominates the history of Tarsiers.[25]

From these quotations, it is clear that, even in his first publications as a trained palaeontologist, Teilhard's view of a general movement of animal evolution towards cerebralization is present. This is also reflected in a paper presented at a meeting of the Institut français d'Anthropologie:

> Considered as a whole ... the branch of Anaptomorphi (or Tarsiers) shows an animal series along which, through a tangle of varied and often divergent forms, the absolute size of the height and the reduction of the face were always growing in relation to the brain. This evolutionary curve is worthy of attention: it is indeed according to a similar process, equally complicated and as long, that the Homo type probably developed.
>
> Hominiens are regarded today by naturalists, either as a branch detached at a late stage from a group of anthropomorphic monkeys (...), or as a stem much older arising in the vicinity of that of the Tarsiers ... – The very early individualization of the Tarsiers, and the parallelism which seems to exist between their evolution and that of the higher Primates, would rather support a third assumption, which could be expressed as follows: the three branches, which respectively ended with Man, the Anthropomorphs and the Tarsiers, are not related to one another from within the Primate group as it is currently defined; but, independently of each other, they come from a still unknown group of very small animals with large brains which must have lived in the Palaeocene, or even in a much earlier era.[26]

Upon completion of his doctoral thesis in 1922, Teilhard was asked to accept the Chair of Geology at the Institut Catholique de Paris – the Chair which had been held by Jean

Boussac. (In fact, the Chair had been initially a Chair of Mineralogy and Geology. It had been awarded to Christophe Gaudefroy, but Gaudefroy was a mineralogist, and he asked that the Chair be split into two, and that of geology given to Teilhard.[27]

This period in Paris was of great importance. From his relationships with Le Roy and Vernadsky, the global vision was further developed, and it is in this period that we have the formulation of the term, 'Noosphere'. This is a useful comparison to the concept of the Biosphere, which also interested Vernadsky, who considered the Biosphere as a gigantic and complex thermodynamic system.[28] During this period, Teilhard also had his first contact with Chinese palaeontology, thanks to a request for his co-operation that came from the Jesuit father Emil Licent, who was organizing a palaeontology museum in Tien Tsin, China. Teilhard spent over a year in China, in 1923 to 1924.

Teilhard returned to Paris in September 1924, and resumed teaching at the Institut Catholique. After the unauthorized distribution of a private note on original sin, Teilhard encountered difficulties with religious authorities and, in the spring of 1926, he went back to China, where he lived and worked (with the exception of a few short visits to France) as a virtual exile for more than twenty years. In spite of these unpleasant events, the China period was for Teilhard very fruitful.

Teilhard's years in China gave him the chance to pursue something new in geology – the global approach. Continental evolution was a way to study the evolution of the whole Biosphere, on a reduced scale, without distortions. Some of the characteristics of evolution which would be lost on a smaller scale – for example, that of population biology – could be discovered through this innovative approach.

The contribution to science provided by this 'continental' approach was explained in one of Teilhard's scientific papers of his China period:

> It is always dangerous to generalize from individual/particular observations. If, however, we have not been misled by factitious arrangement of the facies [i.e., the general aspect or outward appearance of a given growth of flora]and fauna (a superficial and factitious arrangement, because of the too few facts available), the above considerations tend to show that a rigorous study of animal transformation could not be pursued except through the layers of a continent that is vast enough and old enough to have allowed the formation and the conservation of fauna that is unique to that continent.
>
> If one does not take care to select a similar zoological group, the evolutionary phenomena will entirely mask, under external contributions, the internal variations of Life. On the contrary, with a continental stock as we have defined it, the disturbances of a 'cryptogenetic' origin are almost eliminated; and thus the true, organic rhythm of evolution is discovered in the pure state.
>
> The study that we have just made for the top third of Asia leads us to think that this rhythm is extraordinarily slow – comparable even to the slowness with which the continents changed.[29]

Teilhard's dissatisfaction with the traditional ways of doing geology and palaeontology is clear in many of his letters of the period. After a geological congress in Beijing,

he wrote to his friend and colleague Christophe Gaudefroy about the necessity of a new geology:

> I write to you at the close of a fortnight a little more hectic than the preceding ones. To start with, I went to spend six days in the charming city of Peking, on the occasion of a small geological congress about which I have already spoken to you [...]
>
> There were many presentations, almost all dealing with new and significant facts. – What a difference between geology such as one can engage in here and that where the shell-diggers kick about in the ponds of Paris! – It is still the golden age for geological research, in China. – All the same, here as elsewhere, the inventory of the layers and the fossils will not be long in being finished in its broad outline; and I often think that, in a generation, the Science with which I have been occupying myself will start to fade away if one does not succeed in increasing its object, and in changing its methods. There must be a way to approach the study of the Earth in a major and more synthetic way, by considering it as *a whole*, endowed with mechanical, physical, chemical properties, that are *specifically* terrestrial. – It is these properties that it would be necessary to try to uncover, it seems to me, instead of desperately trying to follow, in detail, the activity of tiny causes which influence only minuscule parts of the Earth. *If I had to live my life over again, I would turn towards geodynamics or geochemistry.*[30]

In a letter sent to an unidentified friend who was also a scientist, Teilhard wrote:

> I would be extremely tempted to bring in, to the birth of branches, to the forks, biological causes of a special order, of which the subject would be, not individuals, but the more or less significant parts of the Biosphere. In all the sciences, it seems to me that we yield far too much to the illusion that all the phenomena are representable in miniature, or are explicable by their elements alone. But it is only in geometry that the figures keep their properties while decreasing! The natural groups of living things must have properties which are lacking in things taken in isolation. – I call what I am wishing for a Biology of the Biosphere, – just as we are starting to talk about a Chemistry of the Lithosphere.[31]

The development of the ideas of continental evolution and the global approach is worth noting for another reason. In the first years of his stay in China, during one of his many expeditions, Teilhard had an experience of totality in the Ordos desert – a mystical 'desert experience'. From this experience sprang the idea to write his 'Mass on the World' – one of the greatest mystical texts of the twentieth century.[32] After his exchange with Jean Boussac and his reading of Angela da Foligno, once again science is confronted with the mystical idea of the totality.[33]

With this background, we now have all the elements required to understand Teilhard's scientific research programme, and to show him to be one of the founders of the contemporary science of complexity – that, in science, we can see that the whole has characteristics which are not present in any of its individual components.

Teilhard's research programme was innovative because it focused on characteristics in mammals that had been neglected by the reductionistic method. These characteristics were parallelism and canalization. If one adopts a reductionistic approach, it is impossible to explain these peculiar results of evolution and, thus, impossible to see evolution as a *moving towards*.

Parallelism and canalizations were the new aspects, according to Teilhard, of the old, used and abused, notion of orthogenesis. For Teilhard:

> Besides, orthogenesis can be not only a description of the facts, but a guiding principle for research. It means that a concrete being is never entirely intelligible in isolation, any more than a characteristic can be; it can be understood only in relation to the whole. A like requirement obliges us to see it as a piece within a much larger system. Consequently, in the same way that, in a being taken as a whole, all the parts taken separately mutually imply one another [*se donnent réciproquement*], [...] so also is it possible for us to claim, based only on the examination of a form that has disappeared, that such a collection of preparatory forms of evolutionary stages necessarily prepared for its appearance .... The concept of orthogenesis is thus nothing other than the principle of the correlations applied to the phyletic series.[34]

During his first few years in China, Teilhard had set up his research programme, but it still lacked an experimental validation. In letters to Boule[35], Teilhard mentions his idea to study parallelisms in evolution, and that continental evolution was the best way to study them. Now, parallelisms and canalization – the revision of the theory of orthogenesis – can be shown on the basis of the fossil record. Thus, the final check is still given by fossil evidence, and this is proof that Teilhard's project is a genuine scientific research programme. The best example of group orthogenesis was, according to Teilhard, that of the mole rats of China – the Siphnaeidae.

But Teilhard had yet to describe the Siphnaeidae in all their orthogenetical characteristics. To do so, he had first to find a way to describe carefully the stratigraphy of the Pliocene Reddish clays – a geological stratification he had discovered during his travels in the Spring of 1929. In these reddish clays, Teilhard found fossils of many species of this particular group of rodents. (This formation was also of great interest because it was required in order to do a stratigraphic dating of the remains of the so-called Peking man.) Once he was able to provide a full description of the Pliocene Reddish clays, however, Teilhard was able to trace the evolution of the Siphnaeidae over a long time (20 million years) and on a large (that is, continental) scale, and to prove that canalization and parallelisms were present. At the end of his stay in China, he presented his account of the evolution of the Siphnaeidae as the best result of the application of this method.

The original group was divided into three different branches, but these now-separated branches had developed the same characteristics – an increase in size, inception of continuous growth of the molars and a fusion of the cervical vertebrae – in a parallel way. His paper on the Siphnaeidae closed with these remarks:

> The Biological Significance of Siphnaeidae. – In most zoological groups the complex process of biological evolution is difficult to trace due to excessive dimensions. If any particular group becomes too long-lasting in duration, too widely spread in geographical distribution, or too complex in composition, its various branches also become hopelessly mixed or gaps begin to appear. In order to improve our knowledge of phylogeny we are greatly in need of discovering some animal groups that are long-lived and expanded enough to show internal differentiation, and yet sufficiently limited in time and in space not to be obscured by emigrational depletion or immigrational complications: Quite exceptional, in this respect, are the Siphnaeidae.

> Owing to a lucky coincidence of geological, climatic and ecological factors (protracted and continuous deposition during the late Cenozoic, over a wide and yet sharply limited area, of sub-arid soils where no fossorial form could thrive and become fossilized easily in limy concretions), the Mole-rats represent an ideally rich and old, and, at the same time, ideally simple and closed animal unit. Strictly centreed on a single and closed unit, strictly centreed on a single focus of radiation, slow in their movements, rooted in the soil, and therefore closely confined in N.E. Asia, they represent a practically 'pure' zoological pulsation.
>
> From this point of view, taken as whole, they become just as useful and illuminating in the line of 'group differentiation' and 'Group-orthogenesis' as for instance the Drosophila fly does in the line of Heredity.
>
> Regarded at first as an odd and aberrant type of Asiatic rodents, the Siphnaeidae turn out to be a choice object of research, and perhaps the starting point for new methods of analysis, in the field of general Science.[36]

The experimental evidence necessary to prove the validity of his scientific research programme had been found.

This work, then, provides historical evidence for the claim that Teilhard's scientific research programme had such a global approach and applied the instruments of complexity to science. But Teilhard also achieved something else during his Chinese period. He laid the foundations for a new science, Geobiology, devoted to the study of continental evolution.

Teilhard proposed that the study of the evolution of a branch of animals on a large scale – for example, on a continental level – was the best way to determine the peculiar mechanisms of evolution related to the connection between groups and their habitats (which varied in geological times). Continental evolution was the only way to study the evolution of the Biosphere on a reduced scale without distortion. It was, in other words, the first attempt to develop a branch of science devoted to applying the techniques related to complexity to evolution. Geobiology is, thus, the science of the evolving Biosphere. It includes:

> 1) The study first of all of the organic links of every description that are recognisable between living beings considered *in their totality as a single closed system*; and, 2) Secondly, the study of the physico-chemical links by which the birth and development of this living envelope are bound up with the history of the planet.

In the most general and the highest meaning of the word, therefore, Geobiology seeks to avail itself of the converging effort of all science devoted to Life and Matter, setting before itself the task:

> 1) To analyse the structure and the internal functioning of the Biosphere; and at the same time, 2) of determining the structural and functional place it occupies within the system of other envelopes of this planet; 3) perhaps to find, one day, that these two lines of attack culminate in the discovery of a very general process: that of the building up on the cold stars of increasingly complex material units, progressing from the atom to super-molecule, from super-molecule to the cells, from the free cells to metazoon and thus to the social ensembles.[emphasis in original][37]

Theological and Scientific Perspectives

There is one further point that must not be forgotten. In the 1920s, when he was actively engaged in his scientific research, Teilhard was also writing what he called his 'pious book', *Le Milieu Divin.*[38] Here we see what is, for Teilhard, a next step; the *moving toward* which characterizes evolution does not stop with the emergence of humanity. Humanity has to build the earth as part of the convergence toward what Teilhard called 'the Omega point': the second coming of Christ. Teilhard's global approach, which took into consideration the presuppositions of theology in order to demonstrate the *moving toward* of evolution towards 'humanity', now becomes involved in a new proposal for theology. The *moving toward* continues after the emergence of humanity; it is continued through the actions of human beings thanks to their relationship to God. The result of this process is an earth that is host to a humanity prepared for the second coming of Christ. This is the great theological revolution of Teilhard de Chardin. The actions of Christians are related not only to their personal salvation, but to building the earth in a way which will make the Biosphere ready for that future.

For Teilhard, then, the Bible tells us not only how to go to heaven but, together with science, why and how to build the earth to reach a final evolutionary stage – that is, to *move* the Noosphere *toward* the Omega point, the point characterized by the second coming of Christ. This is the new synthesis proposed by Teilhard, where the ethical dimension of building the earth is necessarily connected with the scientific dimension of the evolution of the Biosphere.

Today it is fair to say that, although original, Teilhard's ideas are not idiosyncratic. From a theological perspective – following Jürgen Moltmann[39] who develops many of the ideas of Teilhard – the Earth has still to be constructed; it is this 'construction' according to the evolutionary model that contributes to the delight of the Creator who rests on the seventh day. And a similar development of Teilhard's ideas can be seen within science. Biospherocentric theories have recently been developed by James Lovelock, with his hypothesis of stability. According to Watson and Lovelock[40], living beings and non-living objects are connected at a global planetary level by negative feedback relationships which allow the stability of the main parameters of the Biosphere. This stability allows life to exist. Developing Teilhard's view, then, the Noosphere has to co-operate with the Biosphere to maintain the stability of those parameters which allow evolution and the *moving towards*. And in order to carry out its own eschatological task, humanity must work actively in the Biosphere to maintain *its* stability.

In short, from the perspective of science, 'building the earth' involves working within the mechanisms which maintain stability – without causing an alteration that may result in catastrophe. The ethical dimension of *moving towards* the building of the earth reflects the scientific account of the relations among living and non-living things that are part of the stability of the Biosphere. Overall, the global approach is key here. When we look at the whole, we see that there is no opposition between the Noosphere and the Biosphere. On the contrary, the Noosphere has its evolutionary origin in the Biosphere, and there are symbiotic connections between the two spheres.

For this reason, any claim that there is an opposition between the Noosphere and the Biosphere, and between Humanity and Nature, is nonsense.

Teilhard's evolutionary approach to building the earth is connected with both theology (that is, the contribution of humanity reflecting its covenant with the divine) and scientific development (that is, the stability and symbiosis in the Biosphere). Thus, the insights of Teilhard de Chardin and his synthesis of science and theology can serve as useful instruments for analysing and understanding the future of both science and theology in the new millennium.[41]

Notes

1 See Pierre Teilhard de Chardin, *L'oeuvre scientifique, 1905–1955*, Nicole and Karl Schmitz Moormann (eds) (Olten und Freiburg im Breislau: Walter-Verlag, 1971), pp. 4580–89.

2 A lengthy discussion has been given elsewhere (see L. Galleni, 'Scienza-e-teologia, il progetto del terzo millennio', Postface to V. Maraldi, *Lo spirito creatore* [Milano: Paoline editoriale libri, 2002]), but we give a short summary here.

3 L. Galleni, *Biologia* (Brescia: La Scuola, 2000).

4 R.J. Hankinson, 'Galen Explains the Elephant', in M. Matthen and B. Linsky (eds), *Philosophy and Biology* [Canadian Journal of Philosophy, Supplementary Volume 14] (Calgary: University of Calgary Press, 1988), pp. 135–57.

5 See Averroé, *Traité Décisif ('Fasl al-Maqal') sur l'Accord de la Religion et de la Philosophie, suivi de l'Appendice* ('Damimah'), Arabic text and French translation, L. Gauthier (ed.) (Alger, 1958).

6 See, among the many editions of the Copernican letters: Galileo Galilei, *Le lettere copernicane*, Massimo Baldini (ed.) (Roma: Armando, 1995).

7 See L. Galleni, *Scienza e Teologia, proposte per una sintesi feconda* (Brescia: Queriniana, 1992), for a brief review of this history.

8 See I. Lakatos, *The Methodology of Scientific Research Programmes*, John Worrall and Gregory Currie (eds) (Cambridge: Cambridge University Press, 1978).

9 See P. Barjon and P. Leroy, *La carrière scientifique de Pierre Teilhard de Chardin* (Monaco: Editions du Rocher, 1964); see also J. Piveteau, *Le Père Teilhard de Chardin savant* (Paris: Fayard, 1964).

10 See Teilhard de Chardin, *L'oeuvre scientifique, 1905–1955*.

11 'Grace à Teilhard, la Paléontologie français, dans le domaine des Mammifères, retrouve, à partir de 1920, une place très honorable.' (Piveteau, *Le Père Teilhard de Chardin savant*, p. 130.)

12 See Zhou Ming Zhen, *Teilhard de Chardin and Chinese Paleontology*, Paper presented at the International UNESCO Symposium on the Occasion of the Centenary of the Birth of Teilhard de Chardin, Paris, September 1981. Mimeographed report. A general reconstruction of his scientific activities and of the preparation of the theoretical aspects of his scientific work has recently been provided by Galleni and Groessens-Van Dyck (L. Galleni, and

M-C. Groessens-Van Dyck, 'Lettres d'un paléontologue, Neuf lettres inédites de Pierre Teilhard de Chardin à Marcellin Boule', *Revue des Questions Scientifiques*, 172 (2001): 3–104), and we will refer to that paper frequently in the following pages.

13 Canalization: the view that developmental processes are robust and resist change.

14 L. Galleni, 'How Does the Teilhardian Vision of Evolution Compare with Contemporary Theories?' *Zygon*, 30/1 (1995): 25–45.

15 'Plus je lis Newman, plus je sens une parenté (combien humble, sans doute!) entre son esprit et le mien. Et une conséquence de cette harmonie est l'excitation que me communique son exemple, de réaliser «*mon*» œuvre. Ici même, dans ce gourbi d'Avocourt, où les obus guettent les pauvres passants, je sens mon âme qui s'enfle du *grand espoir des choses à accomplir* demain, après la guerre. - Oui *je voudrais réconcilier avec Dieu* ce qu'il *y a de bon dans* le Monde moderne, ses intuitions scientifiques, ses appétits sociaux, sa critique légitime. D'une part je vois l'Univers naturel, se mouvant dans une marche *sacrée*, tandis que, de l'autre, j'aperçois Dieu pénétrant et imbibant toute énergie *naturelle*… La *Terre Nouvelle est en formation, partout*. Autour du centre achevé qu'est l'Humanité du Christ (et de sa Mère) la *Nébuleuse est en voie de ségrégation* et de concentration, ses éléments étant partout, bien que partout encore mêlés et diffus, séparables surtout dans leur avenir (bien plus que dans leur présent: l'ivraie ne se distingue pas encore adéquatement du bon grain). Voilà la Réalité … Au lieu de cela, le Monde en Progrès et l' Église évoluante s'ignorent, se défient; elles heurtent des prétentions qui, en réalité, n'existent pas dans un même plan, et dont le choc est un sophisme. Jésus, employez-moi à *faire cesser la méprise*, ou bien, à cette belle Cause, faites servir le sacrifice de ma vie…". (P. Teilhard de Chardin, *Journal [26 aout 1915 – 4 janvier 1919]*, Nicole and Karl Schmitz Moormann (eds) [Paris: Fayard, 1975], pp. 90–91.)

16 'L'adoption de la forme évolutive pour la formation du Monde entraîne un certain mode d'apparition «ex nihilo subjecti», et insinue qu'il y a une *raison ontologique* profonde de ce monde…'. (Teilhard de Chardin, *Journal [26 aout 1915 – 4 janvier 1919]*, p. 264.)

17 See, for the definition of Noosphere, Teilhard de Chardin, *L'oeuvre scientifique, 1905–1955*, p. 4580.

18 M. Ruse, *Monad to Man: the concept of progress in evolutionary biology* (Cambridge, MA: Harvard University Press, 1996).

19 L. Galleni, 'Relationships between scientific analysis and the world view of Pierre Teilhard de Chardin', *Zygon*, 27 (1992): 153–66.

20 See, among others, the letter of 27 March 1916, pp. 46–52. The letters are published in Pierre Teilhard de Chardin et Jean Boussac, *Lettres de guerre inédites* (Paris: O.E.I.L., 1986). Jean Boussac made a copy of his letters to Teilhard and sent them to his wife. This book is of great importance; it is one of the few cases where we have both letters from, and the letters sent to, Teilhard. As a rule, Teilhard never kept the letters he received.

21 'Mon cher Père, combien je vous aime mieux comme savant que comme guerrier! Ici je sympathise complètement avec vous, et cette « unité d'objet », que vous

voulez assigner à notre double vie de chrétien et de naturaliste, me paraît une idée profondément vraie. Mais je vous avoue avoir rencontré rarement cette préoccupation chez mes collègues sorbonnards, généralement incroyants, elle ne peut exister. Et la plupart des savants catholiques séparent complètement leurs occupations scientifiques de leur vie religieuse. Mon beau père est le seul homme chez qui j'ai cru remarquer pareille tournure d'esprit et je crois bien que ce que l'on a appelé la « géopoésie », n'est pas autre chose que le reflet, dans son style et ses oeuvres, de cette tendance informulée.

Au reste, cette conception unitive de la Science et du christianisme ne me paraît pouvoir naître tout d'abord que dans l'esprit d'un géologue, c'est-à-dire d'un savant habitué à contempler l'ensemble de la nature, étudiant à la fois la Terre et la vie qui y règne, et ayant ainsi une vue de la Création plus complète et plus riche que celle que peut avoir un chimiste, par exemple.' (*Lettres de guerre inédites*, pp. 49–50.)

22 'Vous rappelez-vous cette vision de la B^se^ Angèle de Foligno, par laquelle Dieu met sous ses yeux le monde entier en lui donnant à la fois la compréhension de l'ensemble et de tous les détails, et où la Sainte s'écrie : «Mais il est plein de Dieu, il est plein de Dieu, cet Univers!» Le jour où notre science sera assez complète, connaissance et adoration se confondront en un même acte, et c'est ainsi que se réalisera l'unité désirée. La réalisation complète n'aura lieu que dans l'autre monde, mais on peut du moins la préparer dans cette vie.' (*Lettres de guerre inédites*, pp. 50–51.)

23 Teilhard de Chardin, *Journal [26 aout 1915 – 4 janvier 1919],* p. 123.

24 'Tant d'harmonies dans les ressemblances et les différences portent à croire que Pseudoloris (son nom devrait être Protarsius, ou Tarsiculus) appartient réellement au groupe dont sont issus les Tarsiers. Dernier des Pseudoloris et Pseudoloris géants, Tarsius occupe, en quelque façon, parmi les Anaptomorpoidés, pour le développement du crâne, une place symétrique à celle que détient l'Homme parmi les Anthropoïdes.' (*L'oeuvre scientifique, 1905–1955*, p. 232; see also Galleni and Groessens-Van Dyck, 'Lettres d'un paléontologue'.)

25 'Soit par suite de quelque supériorité naturelle, soit plus simplement par chance, la simplification du groupe, d'abord touffu, des Tarsidés, s'est opérée – et sa persistance la plus grande a été obtenue – sur la ligne conduisant au plus grand cerveau.

Un accroissement progressif de la boîte crânienne, voici donc le trait qui domine l'histoire des Tarsidés.' (*L'oeuvre scientifique, 1905–1955*, pp. 239–40.)

26 'Considéré dans son ensemble [...] le rameau des Anaptomorphidés (ou Tarsidés) offre le spectacle d'une série animale le long de laquelle, à travers un enchevêtrement de formes variées et souvent divergeantes, la grandeur absolue de la taille et la diminution de la face au profit du cerveau ont toujours été en croissant. Cette courbe évolutive est digne d'attention: c'est en effet suivant un processus semblable, aussi compliqué et aussi long, que s'est vraisemblablement développé le type *Homo*.

Les Hominiens sont aujourd'hui considérés par les naturalistes, ou bien comme un rameau tardivement détaché du groupe des Singes anthropomorphes [...], ou bien comme une tige beaucoup plus ancienne née au voisinage de celle des

Tarsidés [...]. - L' individualisation très ancienne des Tarsidés, et le parallélisme qui semble exister entre leur évolution et celle des Primates supérieurs favoriserait plutôt une troisième hypothèse, qui pourrait s'exprimer ainsi: les trois rameaux qui ont respectivement abouti à l'Homme, aux Anthropomorphes et au Tarsier ne se rejoignent pas à l'intérieur du groupe Primates tel qu'il est actuellement défini; mais ils sortent, indépendamment les uns des autres, d'un groupe encore inconnu de tout petits animaux à grand cerveau qui a dû vivre au Paléocène, ou même à une époque encore plus ancienne.' (Teilhard de Chardin, *L'oeuvre scientifique, 1905–1955*, p. 216.)

27 See the short biographical note about Gaudefroy by G.H. Baudry, in P. Teilhard de Chardin, *Lettres a l'abbé Gaudefroy et a l'abbé Breuil* (Monaco: Editions du Rocher, 1988), pp. 7–9.

28 See M. Lamotte, *Théorie actuelle de l'evolution* (Paris: Hachette, 1994), p. 18.

29 'Il est toujours dangereux de généraliser des observations particulières. Si cependant nous n'avions pas été abusés par un arrangement factice des faciès et des faunes (arrangement factice et facile, à cause du trop petit nombre de faits dont nous disposions), les considérations qui précèdent tendent à établir qu'une étude serrée des transformations animales ne saurait se poursuivre, qu'à travers les couches d'un continent assez vaste et assez vieux pour avoir permis la formation et la conservation d'une faune "specifique continentale"'.

Si l'on ne prend pas la précaution de sélectionner un pareil groupe zoologique, les phénomènes d'évolution masqueront infailliblement, sous des apports externes, les variations internes de la Vie. Sur un stock continental, au contraire, tel que nous l'avons défini, les perturbations d'origine "cryptogène" sont presque éliminées; et alors le rythme organique, vrai, de l'évolution se découvre à l'état pur.

L'étude que nous venons de faire pour le Tertiaire supérieur de l'Asie donne à penser que ce rythme est d'une lenteur extraordinaire, – comparable à la lenteur même avec laquelle s'altèrent les continents.' (Teilhard de Chardin, *L'oeuvre scientifique, 1905–-1955*, pp. 866–7.)

30 'Je vous écris au sortir d'une quinzaine un peu plus agitée que les précédentes. Pour commencer, je suis allé passer six jours dans la charmante ville de Peking, à l'occasion d'un petit congrès géologique dont je vous ai déjà parlé. [...] Beaucoup de communications, apportant presque toutes des faits nouveaux et importants. – Quelle différence entre la géologie telle qu'on peut la faire ici et celle où marinent les coquillards du bassin de Paris! – C'est encore l'âge d'or pour le recherches géologiques, en Chine. – Tout de même, ici comme ailleurs, l'inventaire des couches et des fossiles ne tardera pas à être terminé dans ses grandes lignes; et je me dis souvent que dans une génération, la Science dont je m'occupe commencera à se faner si on n'arrive pas à agrandir son object, à changer ses méthodes. Il doit y avoir un moyen d'aborder l'étude de la Terre d'une façon plus profonde et plus synthétique, en la considérant *comme un tout*, doué de propriétés mécaniques, physiques, chimiques, *spécifiquement* terrestres. – Ce sont ces propriétés qu'il faudrait arriver à dégager, me semble-t-il, au lieu de s'acharner à suivre, dans le détail, l'action de causes minimes qui n'influencent que d' infimes parties de la Terre. – *Si j'avais à refaire ma*

vie, je m'orienterais vers la géodynamique ou la géochimie.' (Letter of 14 January 1924 to Abbé C. Gaudefroy; see Teilhard de Chardin, *Lettres a l'abbé Gaudefroy et a l'abbé Breuil.*)

31 'Je serais fort tenté de faire intervenir, aux naissances de branches, aux fourches, des causes biologiques d'un ordre spécial, dont le sujet serait, non pas les individus, mais des fractions plus ou moins importantes de la Biosphère. En toutes sciences, il me semble que nous cédons beaucoup trop à l'illusion que tous les phénomènes sont représentables en petit, ou explicables par les seuls éléments. Mais il n'y a qu'en géométrie que les figures gardent leurs propriétés en diminuant! Les blocs naturels des vivants doivent avoir des propriétés qui manquent aux vivants pris isolément. – J'appelle de mes vœux une Biologie de la Biosphère, - comme il commence à y avoir une Chimie de la Lithosphère.' (Teilhard de Chardin, 'Lettres inédites à un savant de ses amis', *Christus*, 54 (1967): 238–58, p. 251.)

32 Chapter 1 of *Hymn of the Universe* (New York: Harper & Row, 1961).

33 See also Teilhard's 'Mon Univers', written on 25 March 1924 and printed in *Science et Christ* (Paris: Editions du Seuil, 1965), pp. 63–114.

34 'L'orthogenèse, d'ailleurs, peut être non seulement une description des faits, mais aussi un fil conducteur pour la recherche. Elle signifie qu'un être concret n'est jamais intelligible isolément, non plus qu'un caractère. celui-ci ne peut s'interpréter que par l'ensemble. Une exigence toute semblable oblige à considérer celui-là comme une pièce dans un système plus vaste. Par suite, de meme que, dans l'etre total, toutes les parties prises séparément se donnent réciproquement, [...] ainsi il est possible d'affirmer, au seul examen d'une forme disparue, que tel ensemble de formes préparatoires d'étapes évolutives en a nécessairement préparé l'apparition. ... La notion d'orthogenèse n'est pas autre chose alors que le principe des corrélations appliqué aux séries phylétiques.' (Piveteau, *Le Père Teilhard de Chardin savant*, p. 51.)

35 See the letters published in Galleni and Groessens-Van Dyck, 'Lettres d'un paléontologue'.

36 Teilhard de Chardin, *L'oeuvre scientifique, 1905–1955*, pp. 3726–7.

37 Teilhard de Chardin, *L'oeuvre scientifique, 1905–1955*, p. 3758.

38 Teilhard de Chardin, *Le Milieu Divin* (Paris: Editions du Seuil, 1957).

39 J. Moltmann, *Gott in der Schöpfung. Okologische Schöpfunglehre,* (München: Chr. Kaiser Verlag, 1985).

40 See A.J. Watson, and J.E. Lovelock, *Biological homeostasis of the global environment: the parable of Daisyworld*, *Tellus*, 35 Series B (1983): 284–9; see also J. Lovelock, *The Ages of Gaia. A Biography of our Living Earth* (London: W.W. Norton, 1988).

41 The authors are grateful to Professor William Sweet, for his careful revisions to the English style and syntax of this paper, and for his translations from the French text of Teilhard.

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Chapter 4

Biology and a Theology of Evolution[1]

Arthur Peacocke

Prologue

I want to begin with a story. It recounts a dazzling vista which we are the first generation of human beings to have vouchsafed to us. It might be called 'Genesis for the Third Millennium'. It is as follows:

There was God. And God was All-That-Was. God's Love overflowed, and God said: 'Let Other be. And let it have the capacity to become what it might be, making it make itself. And let it explore its potentialities.' And there was Other in God, a field of energy, vibrating energy – but no matter, space, time, or form. Obeying its given laws and with one intensely hot surge of energy – a hot big bang – this Other exploded as the Universe from a point 12 (or so) billion years ago in our time, thereby making space.

Swirling fundamental matter appeared, expanded and expanded, and cooled into clouds of gas, bathed in radiant light. Still the Universe went on expanding and condensing into swirling whirlpools of matter and light – a billion galaxies.

Five billion years ago, one star in one galaxy – our Sun – attracted round it matter as planets. One of them was our Earth. On Earth, the assembly of atoms and the temperature became just right to allow water and solid rock to form continents, and mountains grew. And in some deep wet crevice, or pool, or deep in the sea, just over three billion years ago, some molecules became large and complex enough to make copies of themselves and became the first specks of life.

Life multiplied in the seas, diversifying and becoming more and more complex. Five hundred million years ago, creatures with solid skeletons, the vertebrates, appeared. On land, green plants changed the atmosphere by making oxygen. Then 300 million years ago, certain fish learned to crawl from the sea and live on the edge of land, breathing that oxygen from the air. Now life burst into many forms – reptiles, mammals (and dinosaurs) on land, reptiles and birds in the air. Over millions of years the mammals began to develop complex brains which enabled them to learn. Among these were creatures that lived in trees. From these *our* first ancestors derived, and then, 40 thousand years ago, the first men and women appeared. They began to know about themselves and what they were doing; they were not only conscious but also self-conscious. The first word, the first laugh was heard. The first paintings were made. The first sense of a destiny beyond, with the first signs of hope – for they buried their dead with ritual. The first prayers were made to the One who made All-That-Is and All-That-Is-Becoming. The first experiences of goodness, beauty, and truth – but also of their opposites, for human beings were free.

Introduction

That is what some have called the epic of evolution. Whatever we call it, it is a thought framework now sufficiently well established that it is impossible, inconceivable, for us to set ourselves back into the temporal framework that has largely shaped theology, which for the present purposes I will take to be *Christian* theology. That framework is, and has been for two millennia, that of the Bible, which has by and large been the cosmology of the Old Testament, represented explicitly, but not only, in the early chapters of Genesis. The doctrine of creation has largely been shaped by Genesis 1 (together with parts of the Psalms, Prophets, and Wisdom literature). Doctrines concerning human nature have depended strongly on the myths of the Garden of Eden and of the Fall in Genesis, chapters 2 and 3, and so, consequently, have understandings of the work of Jesus the Christ, in particular, theories of atonement; and, of course, much more.

Since theology is in principle the relating of everything to God, it is not surprising that the establishing of this evolutionary perspective has been perceived as a challenge – and even as a threat – to received Christian beliefs about God, nature, and humanity. I hope to show that, far from being a threat, the scientific vista for the twenty-first century constitutes a *stimulus* to theology to become more encompassing and inclusive, but only if it radically expands its currently widely assumed paradigms, not excluding the significance of Jesus the Christ.

To some this might appear an iconoclastic programme. But I have to remind you that Christian theology has been at its most creative and most vital when it has faced the challenges of engagement with new systems of thought encountered in new cultural contexts – the Gentile, then the Hellenistic, and later the works of Aristotle in the twelfth and thirteenth centuries.

We are now living through the most fundamental challenge of all to Christian belief – the fundamental displacement of the basic understandings of nature and of humanity, and consequently also of God, that are being provoked by that new scientific vista with which I began. Early in 1999, the BBC radio morning news program invited listeners to name the 'most significant British figure' – it was the BBC, after all – 'of the second millennium'. You can imagine the list that emerged! In the first three or four, Shakespeare was nearly always included, and very often Churchill, but rarely scientists.

Needless to say, many scientists were shocked by the ignorance of the British public. The lack of attention to Darwin outraged, in particular, Richard Dawkins (who has recently been lecturing on 'universal Darwinism'). His well-known interpretation apart, I do not think he was wrong in choosing Darwin to head his own list. Yet the impact of Darwin, and especially of Darwinism, is looked at askance and with suspicion by many, especially Christian, believers.

But Darwin's uniquely eminent place in the history of biology is totally assured, for he propounded a plausible mechanism for the transformation of species, that of natural selection (the increasing predominance of forms able to produce and rear more progeny as the environment changes). He brilliantly, doggedly, at immense personal cost, showed that the operation of this mechanism was the best explanation of, and made most sense of, widely disparate data. Natural selection was eventually

fully vindicated by the later discovery of the laws of heredity (to which Darwin did not have access) and by developments (molecular biology) in the twentieth century.

As Theodosius Dobzhansky, an Orthodox Christian, famously affirmed, 'Nothing in biology makes sense except in the light of evolution.'[2]

Any theology – any attempt to relate God to all-that-is – will be moribund and doomed if it does not incorporate this perspective into its very bloodstream. Yet much Christian theology simply tinkers apologetically with its beliefs at what seem vulnerable chinks in its armour, assuming that it will survive into what it hopes will be less challenging times. That is a recipe for extinction, for it is with this evolving world on planet Earth that the tragicomedy of human existence is working itself out. We are part of nature, part of an evolving cosmos – indeed we are stardust become persons!

Let us now look, in sequence, at stages in the life process and reflect on their significance for our understanding of nature, humanity, and God, that is, their significance for theology.

I. The Stages of the Life Process and their Significance

1. The Physical Origin of the Universe

Extrapolation backward in time on the basis of known physical relations and observations enables astronomers to trace the evolution of the universe back to when it was only a tiny fraction of a second old, in the form of a compressed fireball hotter than the centre of the Sun. However far astronomers and cosmologists go back, the universe was indisputably physical, consisting of matter–energy–space–time in its most basic forms (for example, a fluctuating quantum field). From this all else has developed; hence it can at least be affirmed (and there will be *much* more to affirm) that all concrete particulars in the world, including human beings, are constituted of fundamental physical entities. This is a *monistic* view in the sense that everything can be broken down into fundamental physical entities and that no *extra* entities are to be inserted at higher levels of complexity (for example, at that of living organisms, no vitalism, no *élan vital*).

This is entirely in accord with the biblical tradition that 'the Lord God formed man of the dust of the ground' (Genesis 2:7 Authorized Version) and that Adam was told 'you are dust and to dust you shall return' (Genesis 3:19).

Such a *monistic* view of the constitution of all entities in the universe, including living organisms and human beings, does *not* mean that in the long run all can be explained by fundamental physics. For what is significant is that the concepts needed to describe and understand each emerging level in the hierarchy of complexity are specific to and distinctive of these levels. Moreover, it very often is the case (but not always) that such concepts are not logically reducible to those used to describe their constituent parts, least of all those pertaining to the fundamental physical building blocks of the universe. When this is the case, and in particular when causal efficacy can be attributed to the way the 'wholes' influence the behaviour of the 'parts', then one is justified in asserting that a new kind of reality has emerged at the higher level

of complexity. Life is emergent from the physico-chemical, the psychological from the neurological, and personhood from the human brain in the human body: all are levels of reality.

2. The Origin of Life

There is a complex and unresolved debate concerning the way there came into existence the earliest entities that could be called living – that could replicate complex biochemical structures that maintain themselves by incorporating molecules from their environment. More than twenty years ago two Nobel laureates, Ilya Prigogine and Manfred Eigen, showed by irreversible thermodynamics and by stochastic molecular kinetics, respectively, that the transformation of certain apparently inchoate physicochemical systems into complex, self-copying systems is likely to occur under certain conditions.

The inability of scientists to find the precise mechanisms of the origin of life has led some to become sceptical about the possibility of life emerging on Earth or even in our galaxy without divine intervention. I think the pioneer thermodynamic and kinetic work I referred to shows that this scepticism is unwarranted and that the emergence of living organisms from non-living matter is a natural phenomenon[3] requiring no 'God of the gaps' to intervene as a *deus ex machina* to ensure its occurrence. For theists, the *whole* process is given its existence, with that potential capacity for life, by God (who is therefore not 'of the gaps').

3. The Duration of Evolution

The oldest rocks to contain fossils of living forms (prokaryotic cells – bacteria and cyanophytes, no nucleus) are 3.5 billion years old, and, because these are already very complex, the origin of life must be located in the first billion years of the Earth's existence, of some 4.5 billion years. If Earth was formed at midnight of the day before yesterday and each hour is equivalent to 100 million (10^8) years, then life first appeared during yesterday morning. Only at 6 p.m. *today* did calcareous (hard) fossils appear; at 6 to 7 p.m. on this second day, the seas fill with shelled creatures; at 8 p.m. with fishes; at 9 p.m. amphibia appear on land; by 11:30 p.m. mammals and the first primates spread across the globe; monkeys and apes at 11:50 p.m.; in the last few minutes of this second day of the Earth hominids arise; and only on the last stroke of tonight's midnight bell would we see tool-making *Homo sapien*s.

During the aeons before our emergence on Earth, hundreds of millions (if not billions) of species have come and gone – the predecessors of the perhaps as many as 15 million species still extant, and rapidly being diminished by human action. Theists who believe that the ultimate ground of all existence is God as Creator have to face new questions: Is it permissible to regard these myriads of species other than *Homo sapien*s, most of them now extinct, as simply by-products in a process aimed at producing human persons? Or do they have value in themselves and for themselves to God as Creator? Surely we now have to escape from our anthropocentric myopia and affirm that God as Creator takes what we can only call joy and delight in the rich variety and individuality of other organisms *for their own sake!*

4. The Mechanism of Evolution: Natural Selection

Darwin's proposition is that species are derived from one another by natural selection of the best procreators. There are no professional biologists who doubt that natural selection is a factor operative in biological evolution; most would say it is by far the most significant one. Some, such as Richard Dawkins, say it is an all-sufficient explanation. It can certainly be subtle in its operation and counter-intuitive with respect to the degree of change and the complexity of new structures and functions it can effect. However, some other biologists are convinced that it is not the whole story, and some even go so far as to say that natural selection alone cannot account for the formation of distinctly new species. What is significant about all these processes is that they all are operating entirely within a naturalistic framework and assume a basically Darwinian process to be operating, although they differ about its speed and smoothness.

Moreover, the depiction of this process and 'nature, red in tooth and claw' (a phrase of the poet Tennyson that actually predates the public proposal of Darwin) is a caricature. For, as many biologists have pointed out,[4] natural selection is not even in a figurative sense the outcome of struggle, in spite of the language of Herbert Spencer ('the survival of the fittest') which Darwin unwisely borrowed.

Death of individual members of a species is essential to survival of the species and to the species' ability to adapt to environmental changes and, if need be, to evolve into a new species. Hence, in evolution we witness new life through death of the old, and believers in God as creating through this process have to accept that the biological death of the individual is the means whereby God was creating new species, including ourselves, aeons before human beings appeared. Thus, we can no longer take Paul's 'the wages of sin is death' (Romans 6:23) to mean that our biological death can be attributed to human sin, as has often been assumed in atonement theories. If we wish to rescue Paul's phrase, we would have to reinterpret it to refer to some kind of spiritual death as being the consequence of sin.

Furthermore, the believer in God as Creator has to view biological evolution through natural selection (and possibly through the other naturalistic processes I mentioned) as simply the means whereby God has been and is creating. There is no prima facie case, as I shall elaborate later, for postulating any special supposed intervention by God in order to understand what has been going on.

5. The Emergence of Humanity

The biological–historical evidence indicates that human nature has emerged only gradually by a continuous process from other forms of primates and that there are no sudden breaks of any substantial kind in the sequences noted by palaeontologists and anthropologists. This is not to say that the history of human culture is simply a smoothly rising curve. There must have been, for example, key turning points or periods. However, there is *no* past period for which there is reason to affirm that human beings possessed moral perfection or existed in a paradisal situation from which there has been a subsequent decline. All the evidence points to a creature slowly emerging into awareness, with an increasing capacity for consciousness and

sensitivity and the possibility of moral responsibility and, the religions would affirm, of response to God (especially after the axial period around 500 BCE). So there is no sense in which we can talk of a 'fall' from a past perfection. We appear to be rising beasts rather than fallen angels, rising from an amoral (and in that sense) innocent state to the capability of moral and immoral action.

What is also true is that humanity manifests aspirations to a perfection not yet attained, a potentiality not yet actualized, but no original righteousness. Sin as alienation from God, humanity, and nature is only too real and appears as the consequence of our very possession of that *self*-consciousness by which we always place ourselves at the egotistical centre of the universe of our consciousness that has evolved biologically. Classical concepts of the Fall as a *past* event that dominate Christian theologies of redemption urgently need, it seems to me, to be rescinded, and we need to rethink what we mean by redemption if it is to make any sense to our contemporaries.

So the questions of not only 'Who are we?' but even 'What should we be becoming? Where should we be going?' remain acute for us.

6. Human Behaviour

Human behaviour thus comes into focus, and our understanding of it has been enriched by the new sciences of sociobiology and behaviour genetics. Sociobiology is the systematic study of the biological, especially genetic, basis of patterns of social behaviour in socially organized species, including the human, and aspires to include even human culture in its purview. Behaviour genetics aims to examine over a wide range the inheritance of many different behaviours in individual organisms, again including humanity. These studies, which do not necessarily have to be pursued with excessively reductionist ambitions, cannot but influence our general assessment of human nature and of the genetic constraints and limitations under which free will operates. Theologians should acknowledge that it is this kind of genetically based creature that God has actually created as a human being through the evolutionary process. However, that heritage cannot itself determine in advance the *content* of our thinking, for example of our moral reasoning. Just as science is not magic, so ethics, on the same grounds, is not genetics.

Even so, the Christian theologian does not have to enter this debate with destructive ambitions. For if God, as a scientifically sensitive theology affirms, is creating immanently through the evolutionary processes, it would not be inconsistent with such a theology for human moral awareness to have originated sociobiologically. Moreover, humanity could have survived and flourished only if it held social and personal values that transcended the urges of the individual, embodying 'selfish' genes – and these values stem from the sense of a transcendent Good.

7. Evolution and Human Rationality

Evolutionary biology can trace the steps in which successive organisms have acquired nervous systems and brains whereby they obtain, store, retrieve, and utilize information about their environments in a way that furthers their survival.

Our sense impressions must be broadly trustworthy, and so must the cognitive structures whereby we know the world; otherwise we would not have survived. In the case of human beings these cognitive faculties include the representations of external reality we individually and socially make to ourselves and must have enough verisimilitude to facilitate survival in the external realities of our environments. This gives us grounds for confidence in the reality-referring capacity of the cognitive processes with which evolution has provided us. It warrants the postulating of the existence of a general rationality in *Homo sapiens* that yields, for the purpose of living, reliable knowledge and justified belief. It is a healthy corrective to the epidemic of relativism associated with postmodernism, for it supports the conviction that our cognitive processes can refer to 'reality' – that which we cannot avoid taking account of in our diagnoses of our experience and (in science) of our experiments.

8. The Paradox of Human Non-adaptedness

Oddly enough, there are signs of a kind of misfit between human beings and their environment which is not apparent in other creatures. We alone in the biological world, it seems, individually commit suicide; we alone in our prehistory give evidence by our burial rituals of the sense of another dimension to existence; we alone go through our lives with a sense of incompleteness evidenced by the contemporary quests for self-realization and personal growth. Human beings seek to come to terms with death, pain, and suffering, and we need to realize our own potentialities and learn how to find our way through life. The natural environment is not capable of satisfying such aspirations, nor can the natural sciences describe, accurately discern, or satisfy them. For we are capable of joys and miseries quite unknown to other creatures, thereby evidencing a disease with our evolved state, a lack of fit which calls for explanation and, if possible, cure.

This alienation of human beings from non-human nature and from each other appears as a kind of anomaly within the organic world. We may well ask, Why has, how has, the process whereby there have so successfully evolved living organisms finely tuned to and adapted to their environments failed in the case of *Homo sapiens* to ensure this fit between lived experience and the environing conditions of their lives?

Such considerations raise the further question of whether or not human beings have identified what their *true* environment really is, that environment in which human flourishing is possible. Does not the human condition raise the profound question of what humanity's true environment really is, of the nature of that reality to which it must relate? Did not Saint Augustine (*Confessions* I.1.1), after years of travail and even despair, address his Maker: 'You have made us for yourself and our heart is restless till it rests in you'?

9. Extraterrestrial Life

I have said enough to show that if the chemical conditions were right on a planet of about the same age as the Earth, moving around a star of about the age of our sun, then it is probable that living forms of matter would have appeared on it; and, with

a lower but non-zero probability, that intelligent creatures would have emerged by the operation of natural selection. The physical form of these living extraterrestrial intelligences would, of course, almost certainly be very different from ours.

Christians have to ask themselves (and sceptics will certainly ask *them*) what the cosmic significance can possibly be of the localized, terrestrial event of the existence of the historical Jesus. Doesn't the mere possibility of extraterrestrial life render nonsensical all the superlative claims made by the Christian Church about his significance? Would 'E.T.', Martians, and the neighbours of Upsilon-Andromeda (the latest candidates for extraterrestrial life) need an incarnation and all it is supposed to accomplish as much as *Homo sapiens* on planet Earth? A contemporary theology has to cope convincingly with such questions in order to be credible.

II. General Features of Evolution

1. Chance and Law

We have already discussed the creative interplay of chance and law in the evolution of living matter by natural selection. As is well known, Jacques Monod (1972) concluded that the 'stupendous edifice of evolution' is, in this sense, rooted in 'pure chance', and that therefore all inferences of direction or purpose in the development of the biological world in particular and of the universe in general must be false.[5]

However, there is no reason why the randomness of molecular events in relation to biological consequence has to be given the metaphysical status that Monod attributed to it. It would be more consistent with observation to assert that the full gamut of the potentialities of living matter can be explored only through the agency of the rapid and frequent randomization that is possible at the molecular level of DNA. This interplay of chance and law is the basis of the inherent creativity of the natural order, its ability to generate new forms, patterns, and organizations of matter and energy. One might say that the potential of the *being* of the world is made manifest in the *becoming* that the operation of chance makes actual. God is the ultimate ground and source of both law (necessity) and chance.

A theist must then see God as acting rather like a composer extemporizing a fugue to create in the world through what we call 'chance' operating within the created order, each stage of which constitutes the launching pad of the next. The Creator, it now seems, is unfolding the divinely endowed potentialities of the universe, in and through a process in which these creative possibilities and propensities become actualized within created time.

2. Trends and Directions in Evolution?

Can God be said to be implementing any purpose in biological evolution? Or is the whole process so haphazard, such a matter of happenstance, that no meaning, least of all a divinely intended one, can be discerned in the process? Popper has pointed out that the realization of possibilities, which may be random, depends on the total situation within which the possibilities are being actualized, so that 'there

exist weighted possibilities which are more than mere possibilities, but tendencies or *propensities* to become real', and that these '*are properties of the whole situation*'.[6] Propensities are simply the effects of the context on the outcomes of random events. I suggest that the evolutionary process is characterized by propensities, evoked by natural selection, toward increase in complexity, information processing and storage, consciousness, sensitivity to pain, and even self-consciousness (a necessary prerequisite for social development and the cultural transmission of knowledge down the generations). Some successive forms, along some evolutionary branch or twig, have – through the operation of natural selection – a distinct probability of manifesting more and more of these characteristics. However, the actual physical form of the organisms in which these propensities are actualized is contingent on the history of the crossing of disparate chains of events.

Stephen J. Gould has interpreted the extraordinary fossils of very early (*c*.530 million years ago) soft-bodied fauna found in the Burgess Shale of the Canadian Rockies as representing a maximum in disparity of forms – after which, he claims, there was a dramatic decline in the range of types (phyla) of species. Hence, he claims, if the 'tape' of evolutionary history could be rerun, all the phyla and species would be totally different, and no intelligent persons in the form of *Homo sapiens* would appear.[7] However, S. Conway Morris, an evolutionary palaeobiologist who has devoted his research life to the study of the Burgess Shale and related formations, argues that Gould has in fact overemphasized the role of contingency and that his argument is based on a 'basic confusion concerning the destiny of a given lineage. ... Nearly all biologists agree that convergence is a ubiquitous feature of life.'[8] 'Again and again we have evidence of biological form stumbling on the same solution to a problem.'[9] 'The reality of convergence suggests that the tape of life, to use Gould's metaphor, can be run as many times as we like and in principle intelligence will surely emerge.'[10] There can, it seems *(pace* Gould), be overall direction and implementation of divine purpose through the interplay of chance and law without a deterministic plan fixing all the details of the structure(s) of what emerges as possessing personal qualities.

Incidentally, I see no need to postulate any special action – any non-natural agent pushing, or pulling, or luring, for example, by some divine manipulation of mutations at the quantum level – to ensure that persons emerge in the universe, and in particular on Earth.

3. The Ubiquity of Pain, Suffering, and Death

The ability for information processing and storage is indeed the necessary, if not sufficient, condition for the emergence of consciousness. Sensitivity to an organism's surroundings inevitably involves an increase in its ability to experience pain, which constitutes the necessary biological warning signal of danger and disease. Insulation from the surrounding world in the biological equivalent of three-inch nicked steel would be a sure recipe for preventing the development of consciousness.

New patterns can come into existence in a finite universe (finite in the sense of the conservation of matter-energy) only if old patterns dissolve to make a place for them. Biological death of the individual is the prerequisite for the creativity of the

biological order, that creativity which eventually led to the emergence of human beings.

Hence, pain, suffering, and death, which have been called 'natural evil', appear to be inevitable concomitants of a universe that is creative of new forms, some of which are conscious and self-conscious.

For any concept of God to be morally acceptable and coherent, and if God is also immanently present in and to natural processes, then we cannot but infer that – in some sense hard to define – God, like any human creator, suffers in, with, and under the creative processes of the world with their costly unfolding in time.

There has been an increasing assent in the Christian theology of recent decades to the idea that it is possible 'to speak consistently of a God who suffers eminently and yet is still God, and a God who suffers universally'.[11] God, we find ourselves having tentatively to conjecture, suffers the natural evils of the world along with ourselves, because (we can only hint at this stage) God intends to bring about a greater good thereby, namely, the kingdom of free-willing, loving persons in communion with God and with each other.

4. Complexity and Causality

Finally, another general feature of the evolving biological world is proving to be increasingly of general philosophical and theological significance, namely, the nature of the intricate complexity of living systems, of the principles by which this unfolds, and of the nature of causality operating in them. For we do not have simple causal chains of the kind A→B→C→D ..., interaction of any stage of which inhibits the process, but webs of interconnection in which the state of the whole system influences the behaviour of its parts.

I, for one, have found this to be fruitful in thinking about how God might affect patterns of events in the world without intervening, that is, without abrogating any of the laws that have been found, and continue to be found, to govern patterns of events as studied at their own level.[12] I postulate whole-part influence as a clue to the understanding of God's interaction with the world (and possibly also to understanding personal agency and the mind–body problem).

III. A Theology of Evolution

It is gradually being realized that, far from the epic of evolution being a threat to Christian theology, it is in fact a stimulus to and a basis for a more encompassing and enriched understanding of the interrelations of God, humanity, and nature. An argument for the existence of God in Anglo-Saxon *physico-theology* (an eighteenth-century form of natural theology) was based on the intricacy of particular biological mechanisms which was attributed to the direct action of God the Designer. This argument collapsed in the nineteenth century when Darwin and his successors showed that this apparent 'design' could evolve by a purely natural process based on scientifically intelligible relationships. But even in the nineteenth century, many Anglican theologians, both evangelical and catholic, embraced positively the

proposal of evolution. Of the former, one can think of Charles Kingsley, who in his *Water Babies*[13] affirms that God makes 'things make themselves'; and of the latter, we may instance Aubrey Moore, who in *Lux Mundi* (a publication of a group of Oxford Anglicans) wrote, 'Darwinism appeared, and, under the disguise of a foe, did the work of a friend. It has conferred upon philosophy and religion an inestimable benefit, by showing us that we must choose between two alternatives. Either God is everywhere present in nature, or He is nowhere.'[14]

1. God and the World

(i) Immanence Such an emphasis on the *immanence* of God as Creator in, with, and under the natural processes of the world unveiled by the sciences is certainly in accord with all that the sciences have revealed since those debates of the nineteenth century. For a notable aspect of the scientific account of the natural world in general is the seamless character of the web that has been spun on the loom of time – at no point do modern natural scientists have to invoke any non-natural causes to explain their observations and inferences about the past. As Howard J. Van Till has so powerfully expressed it, 'the formational economy'[15] of the universe is sufficiently robust to make possible the actualization of all inanimate structures and all life forms that have ever appeared in the course of time.[16] The processes that have occurred can, as we saw, be characterized as processes of *emergence*, for new forms of matter, and a hierarchy of organization of these forms themselves appear in the course of time. New kinds of reality may be said to emerge in time.

The scientific perspective of the world, especially the living world, inexorably impresses upon us a *dynamic* picture of the world of entities and structures involved in continuous and incessant change and in process without ceasing. This impels us to reintroduce into our understanding of God's creative relation to the world a dynamic element which was always implicit in the Hebrew conception of a living God, dynamic in action – even if obscured by the tendency to think of creation as an event in the past. God has again to be conceived of as continuously creating, continuously giving existence to, what is new. God is creating at every moment of the world's existence in and through the perpetually endowed creativity of the very stuff of the world.

All of this reinforces the need to reaffirm more strongly than at any other time in the Christian (and Jewish and Islamic) traditions that in a very strong sense God is the immanent Creator *creating in and through the processes of the natural order*. The processes are not themselves God but the *action* of God as Creator. God gives existence in divinely created time to a process that itself brings forth the new: thereby God is *creating.* This means we do not have to look for any extra supposed gaps in which, or mechanisms whereby, God might be supposed to be acting as Creator in the living world.

(ii) Panentheism[17] Classical philosophical theism maintained the ontological distinction between God and creative world that is necessary for any genuine theism by conceiving them to be of different *substance*s, with particular attributes predicated of each. There was a 'space' *outside* God 'in' which the realm of created substances existed. This substantival way of speaking has become inadequate in my view and

that of many others. It has become increasingly difficult to express the way in which God is present to each other. God can only intervene in the world in such a model. This inadequacy of classical theism is aggravated by the evolutionary perspective, which, as we have just seen, requires that natural processes in the world need to be regarded *as such* as God's creative action. In other words, the world is to God rather as our bodies are to us as personal agents – with the necessary caveat that the ultimate ontology of God as Creator is distinct from that of the world. Moreover this *personal* model of embodied subjectivity (with that essential caveat) better represents how we are now impelled to understand God's perennial action in the world as coming from the inside. These considerations lead to the idea of a panentheistic relation of God and the world.

Panentheism is 'the belief that the Being of God includes and penetrates the whole universe, so that every part of it exists in Him but (as against pantheism) that His Being is more than, and is not exhausted by, the universe.'[18] Recall Paul's address at Athens when he says of God that 'In him we live and move and have our being' (Acts 17:28 RSV). It is in fact also deeply embedded in the Eastern Christian tradition.

(iii) The Wisdom (Sophia) and the Word (Logos) of God Biblical scholars have in recent decades come to emphasize the significance of the central themes of the so-called Wisdom literature (Job, Proverbs, Ecclesiastes, Ecclesiasticus, and Wisdom). In this broad corpus of writings the feminine figure of Wisdom (*Sophia*), according to J.G. Dunn, is a 'convenient way of speaking about God acting in creation, revelation and salvation; Wisdom never becomes more than a personification of God's activity'.[19] This Wisdom endows some human beings, at least, with a personal wisdom that is rooted in their concrete experiences and in their systematic and ordinary observations of the natural world – what we would call science. But it is not confined to this and represents the distillation of wider human, ethical, and social experiences. All such wisdom, imprinted as a pattern on the natural world and in the mind of the sage, is but a pale image of the divine Wisdom – that activity distinctive of God's relation to the world. In the present context, it is pertinent that this important concept of Wisdom (*Sophia*) unites intimately the divine activity of creation, human experience, and the processes of the natural world. It therefore constitutes a biblical resource for imaging the panentheism we have been urging.

So also does the closely related concept of the Word (*Logos*) of God, which is regarded (John 1:1) as existing eternally as a mode of God's own being, as active in creation, and as the self-expression of God's own being and becoming imprinted in the very warp and woof of the created order. Again we have a panentheistic notion that unites intimately, as three facets of one integrated and interlocked activity, the divine, the human, and the (non-human) natural. It is, needless to say, significant that for Christians this *Logos* was regarded as 'made flesh' (John 1:14) in the person of Jesus the Christ.

(iv) A Sacramental Universe The evolutionary epic, as I have called it for brevity, in its sweep and continuity actualizes over aeons of time the mental and spiritual potentialities of matter, especially in the evolved complex of the human-brain-in-the-human-body. The original fluctuating quantum field, quark soup (or whatever)

has in some ten or so billion years become a Mozart, a Shakespeare, a Buddha, a Jesus of Nazareth – and you and me!

Every advance of the biological, cognitive, and psychological sciences shows human beings as psychosomatic unities – that is, as persons. Matter has in us manifested personal qualities, that unique combination of physical, mental, and spiritual capacities.[20]

For the panentheist, who sees God working in, with, and under natural processes, this unique end result (to date) of the evolutionary process corroborates that God is using that process as an *instrument* of God's purposes and as a *symbol* of the divine nature, that is, as the means of conveying insight into these purposes.

But in the Christian tradition, this is precisely what sacraments do. They are valued for what God is effecting instrumentally and for the meaning God is conveying symbolically through them. Thus William Temple came to speak of the 'Sacramental Universe'[21] and we can come to see nature as sacrament, or at least as sacramental. Hence my continued need to apply the phrase 'in, with, and under', which Luther used to refer to the mode of the Real Presence of Christ in the Eucharist, to the presence of God in the processes of the world.

Such reflections lead us, finally, to reflect on:

2. Humanity and Jesus the Christ in an Evolutionary Perspective

We have already seen in the section on human non-adaptedness that human beings are incomplete, unfinished, falling short of that instantiation of the ultimate values of truth, beauty, and goodness that God, their ultimate source, must be seeking to achieve in order to bring them into harmonious relation to Godself. We have not yet become fully adapted to the ultimate, eternal environment of God.

It was not long after Darwin published that some theologians began to discern the significance of the central distinctive Christian affirmation of the Incarnation of God in the human person of Jesus the Christ as especially congruent with an evolutionary perspective. Thus, again in *Lux Mundi* in 1891, we find J.R. Illingworth boldly affirming that 'in scientific language, the Incarnation may be said to have introduced a new species into the world – a Divine man transcending past humanity, as humanity transcended the rest of the animal creation, and communicating His vital energy by a spiritual process to subsequent generations.'[22]

In this perspective, Jesus the Christ, the whole Christ event, has, I would suggest, shown us what is possible for humanity. The actualization of this potentiality can properly be regarded as the consummation of the purposes of God already incompletely manifested in evolving humanity. In Jesus there was a *divine* act of new creation, because Christians may now say the initiative was *from God*, within human history, within the responsive human will of Jesus inspired by that outreach of God into humanity designated as God the Holy Spirit. Jesus the Christ is thereby seen, in the context of the whole complex of events in which he participated as the paradigm of what God intends for all human beings, now revealed as having the potentiality of responding to, of being open to, of becoming united with, God. In this perspective, he represents the consummation of the evolutionary creative process which God has been effecting in and through the world.

The ever-present self-expression in all-that-is of God as Word or *Logos* attains its most explicit personal revelation in Jesus the Christ. But because it is a (unique) manifestation of this eternal and perennial mode of God's interaction in, with, and under the created order, what was revealed in Jesus the Christ could also, in principle, be manifest both in other human beings (and so in the other world religions) and indeed also on other planets, in any sentient, self-conscious, *non-human* persons that inhabited them who are capable of relating to God (whatever their physical form). This vision of a universe permeated by the ever-acting, ever-working, and potentially explicit self-expression of the divine Word/*Logos*/Son as incarnated in extraterrestrial personal beings was adumbrated in a poem of Alice Meynell:[23]

Christ in the Universe
With this ambiguous earth
His dealings have been told us. These abide:
The signal to a maid, the human birth,
the lesson and the young Man crucified.

But not a star of all
The innumerable host of stars has heard
How he administered this terrestrial ball.
Our race have kept their Lord's entrusted Word. ...

Nor, in our little day,
May his devices with the heavens be guessed,
His pilgrimage to thread the Milky Way,
Or his bestowals there be manifest.

But, in the eternities,
Doubtless we shall compare together, hear
A million alien Gospels, in what guise
He trod the Pleiades, the Lyre, the Bear.

For the epic of evolution has been consummated in the Incarnation in a human person of the cosmic self-expression of God, God's Word – and in the hope this gives to all self-conscious persons of being united with that Source of all Being and Becoming which is the 'Love that moves the heavens and the other stars' (the closing lines of Dante's *Paradiso*).

May I suggest that, in the second century, Irenaeus said it all, in inviting us to contemplate:

The Word of God, our Lord Jesus Christ
Who of his boundless love
became what we are
to make us what even he himself is.
(*Adversus Haereses,* V, praef.)

Notes

1 Reprinted, with the permission of the editor and the author, from *Zygon: Journal of Religion and Science*, 34/4 (1999): 695–712.
2 Theodosius Dobzhansky, *American Biology Teacher* (Washington, DC: National Association of Biology Teachers, 1973).
3 This view is strongly urged by the Nobel laureate Christian de Duve. See his *Vital Dust* (New York: Basic Books, 1995) and 'Constraints on the Origin and Evolution of Life', *Proceedings of the American Philosophical Society*, 142 (1998): 1–8. The argument about so-called intelligent design still rages, but it has in my view been convincingly refuted by Howard Van Till in 'Does "Intelligent Design" Have a Chance? An Essay Review', *Zygon: Journal of Religion and Science*, 34 (1999): 667–82. An earlier version appeared in *Perspectives: A Journal of Reformed Thought*, 13 (December 1998): 21–2.
4 George Simpson, *The Meaning of Evolution*, (New Haven: Bantam Press/Yale University Press, 1971), p. 20.
5 Jacques-Lucien Monod, *Chance and Necessity* (London: Collins, 1972).
6 Karl R. Popper, *A World of Propensities* (Bristol: Thoemmes, 1996), pp. 12, 17; emphasis added.
7 Stephen J. Gould, *Wonderful Life: The Burgess Shale and the Nature of History* (London: Penguin Books, 1989).
8 S. Conway Morris, *The Crucible of Creation: The Burgess Shale and the Rise of Animals* (Oxford: Oxford University Press, 1998) pp. 201, 202.
9 Morris, *The Crucible of Creation,* p. 204.
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11 Paul Fiddes, *The Creative Suffering of God* (Oxford: Clarendon Press, 1983), p. 3.
12 Originally in 1987, then in *Theology for a Scientific Age: Being and Becoming – Natural and Divine* (Oxford: Blackwell, 1990) and most recently in 'The Sound of Sheer Silence – How Does God Communicate with Humanity?' in *Neuroscience and the Person: Scientific Perspectives on Divine Action*, R.J. Russell, N. Murphy, T. Meyering, and M. Arbib (eds) (Vatican City State: Vatican Observatory, and Berkeley: Center for Theology and the Natural Sciences, 1999), pp. 309–41.
13 Charles Kingsley, *The Water Babie*s (London: Hodder and Stoughton, 1930), p. 248. (Originally published in 1863).
14 Aubrey Moore, 'The Christian Doctrine of God', In *Lux Mundi*, C. Gore (ed.) (London: John Murray, 12th ed., 1891) chap. 2, p. 73.
15 By 'formational economy' Van Till means 'the set of all the dynamic capabilities of matter and material, physical, and biotic systems that contribute to the actualization of both inanimate structures and biotic forms in the course of the universe's formational history' ('The Creation: Intelligently Designed or Optimally Equipped?', *Theology Today*, 55 [1998]: 344–64); he draws special attention to capabilities for self-organization and transformation.
16 Van Till, 'Does "Intelligent Design" Have a Chance?', p.351.
17 For further exposition, see Peacocke, *Theology for a Scientific World* (London:

SCM, and Minneapolis: Fortress Press, 2nd enlarged ed., 1993), pp. 370–72; Peacocke, 'A Response to Polkinghorne', *Science and Christian Belief*, 7 (1995): 109–10; Philip Clayton, 'The Case for Christian Panentheism', *Dialog*, 37 (1998): 201–208 – to which this account is greatly indebted.

18 *Oxford Dictionary of the Christian Church*, s.v. 'panentheism', F.L. Cross and E.A. Livingstone (eds) (Oxford: Oxford University Press, 1983), p. 1027. See also Augustine, *Confessions* VII.7, quoted in Peacocke, *Theology for a Scientific Age*, p. 159.

19 J.G. Dunn, *Christology in the Making* (London: SCM Press, 1980), p. 210.

20 I use *spiritual* as indicating 'relatable to God in a personal way'.

21 William Temple, *Nature, Man, and God* (London: Macmillan, 1934), ch. 19.

22 J.R. Illingworth, 'The Incarnation in Relation to Development', in *Lux Mundi*, C. Gore (ed.) (London: John Murray, 12th ed., 1891), pp. 151–2. But we cannot today use for this transformation Illingworth's phrase 'a new species' in any literal sense, for *species* is for us now a purely biological term.

23 Alice Meynell, 'Christ in the Universe', in *The Faber Book of Religious Verse*, Helen Gardner (ed.), (London: Faber and Faber, 1972), p. 292.

PART II
Physics, Philosophy, and Fine-Tuning

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Chapter 5

Creation, Metaphysics, and Cosmology

Lawrence Dewan, O.P.

> One might think that modern science – because, while remaining *science,* and not becoming *history*, it has nevertheless introduced into its knowledge of nature the dimension of historical development, and conceives the world as a universe in expansion, evolving from a primitive state and submitted to a sort of aging process (for which the principle of increase of entropy is the most striking symbol), – inclines the philosopher to hold it as probable that the world (which the philosopher knows to be *created*) has had a *first beginning*; modern science furnishes, at any rate, for our imagination a much more favorable frame for this idea of a first beginning than was the stationary universe of Greek science. Still, what remains essential for philosophy, and in the domain of assertions of reason, is only the strictly demonstrable certitude that the world is *created*; even if it had *always* existed ...
>
> Jacques Maritain[1]

Introduction

Anyone reading the reports in the public press about cosmology knows that this is at present an area of extreme fermentation in mathematical physics. However, one of the seeming constants in the discussion, as one looks back over the last 50 years, is the inclination of some of those involved to speak of 'creation,' and even of the origin of things as a coming from 'nothing' (in some sense). This came on the scene with indications of cosmic objects moving farther apart, with attendant Big Bang or Steady State models of the universe.[2] In recent years we find scientists like J.A. Wheeler speaking of 'the creation question' and describing himself as 'constructing the universe out of nothing'.[3]

Besides the scientists themselves, there are philosophers who pursue this line of thinking. Thus, we have the case of William Lane Craig who sees in the Big Bang singularity a beginning of the universe from nothing, and a premise on which to base a proof of the existence of a God.[4]

My interest is, first of all, in the doctrine of creation as a doctrine of religion based on a revelation. Secondly, I am interested in what this doctrine has meant in the history of metaphysics. Taking these areas seriously, I wish to indicate how alien to these matters the field of contemporary cosmology is (existing though it does in the context of their cultural influence).

Revelation, Creation, and Theology

Let us begin by recalling the text of Genesis: 'In the beginning, God created heaven and earth.' Exegetes differ as to the conception of creation or production here envisaged. Is a making 'out of nothing' intended? The *Bible de Jérusalem* tells us that 'creation' is expressed here by the Hebrew verb *bara* which is reserved for the creative action of God, different from the sort of production engaged in by man. However, one should not, it advises, introduce the 'metaphysical' notion of creation *ex nihilo*, which will not be formulated before 2 Maccabees 7:28.[5] The *Bible de Jérusalem* presents the Genesis sentence as a *title*, with the actual account beginning in the *second* verse: 'The earth was without form and void …' [Revised Standard Version], and concluding with Genesis 2.4. Thus, the history begins with the earth already present, but in a condition described as 'without form and void'. These negative images *prepare* the idea of a creation 'from nothing', but do not themselves mean that.[6]

Some exegetes contest the presence of the notion of production from nothing in 2 Maccabees 7:28 as well. Gerhard May[7] argues that biblical texts such as 2 Maccabees simply do not address such issues as the creation of matter, and take for granted some sort of item on which God works. However, he holds that the biblical doctrines of divine omnipotence and freedom have the doctrine of creation out of nothing as their proper implication. Thus, he presents the explicitation. The important names for the doctrine are Tatian,[8] Theophilus of Antioch,[9] and Irenaeus of Lyons.[10] It is with the last-mentioned that we get the fullest statements of the creation of matter by God. Irenaeus, writing at the end of the second century, insists on the divine will as source even of the substance of matter. This is in opposition to both 'Platonic' formation doctrine and Gnostic doctrines. May presents Irenaeus as philosophically naïve, but nevertheless sees in Theophilus and Irenaeus the people who really put creation out of nothing into the mainstream.[11]

So much for the introduction of the doctrine. In keeping with the Book of Genesis, it presents a beginning of the *history* of the universe, rather than a sort of a-temporal myth of production. In keeping with the Old Testament conception of God as omnipotent, it tolerates no item as standing outside the field of divine production.

The metaphysics of creation was brought to perfection especially in the thirteenth century with Thomas Aquinas. We can see something of this if we contrast the Cologne classroom of Albert the Great, in the thirteenth century, and a work of his for which his remarkable pupil, Thomas Aquinas, served as secretary,[12] with the doctrine Thomas himself would soon after teach. Considering the modes of production of reality proposed by the philosophers, Albert holds that Plato and Avicenna see the coming forth of things from God as a coming forth of forms (matter already in existence), and a coming forth according to necessity of the divine nature (as distinct from divine choice):

> … since the issuing forth of things from the First [Principle] was merely as to form, like that of illumination from the first light, as acting from the necessity of his own form, one can find no way that matter could have proceeded from him: hence, it was necessary to posit eternal matter, which is against the Faith. And therefore we follow the opinion of Aristotle, which seems more Catholic.[13]

However, Albert does not think that Aristotle held a doctrine of creation.[14] What he approves in Aristotle is the doctrine of forms being educed from the potency of matter. This makes *possible* a doctrine which would see the absolutely first cause as cause even of matter.

Most important, later in the same work we find him teaching that creation as including the production of matter is not compatible with the eternity of the universe: only Avicenna's sort of 'creation', which is merely the creation of form,[15] not of matter, allows the doctrine of eternal creation:

> … God is indeed the perfect agent and can bring the entirety of the thing into being, but these are not mutually compatible, [1] that something be brought into being as regards the entirety of its substance, i.e. as regards [both] the matter and the form, and [2] that it be from eternity: because that sort of creation [*talis creatio*] [i.e. #1] necessarily posits a beginning of duration, though the 'creation' of which Avicenna speaks, which is only of forms, can be understood as from eternity.[16]

If we look now at Albert's pupil, Thomas Aquinas, we see a very different judgment about these issues. In his *Commentary on the Sentences of Peter Lombard*, composed in the years immediately following his time with Albert in Cologne, Thomas already attributes a doctrine of production of total substance, matter as well as form, to Aristotle![17] Thomas distinguishes carefully the issues of [1] *dependence* of total substance on one first principle and [2] the *duration* of the dependent substance. Where Albert the Great thought one could not dissociate the causing of matter from a beginning of duration, Thomas's conception of matter is such that God, the first principle who is eternal, can cause matter to be from eternity. Where Thomas draws the line between what human investigation can ascertain and what can only be known on the basis of a special divine revelation is precisely the question: what is the actual duration of created reality? This is the question: is it, so to speak, a 'historical' fact that the universe had a beginning of duration? It is on this issue alone that the human mind is completely in need of special divine help, not on the question: does reality through and through, as regards everything which constitutes its substance, depend on a first principle?

Theology Uses Metaphysics

In the texts of Albert we see a recognition of two uses of the word 'creation', one by the philosophers and another by the Christian. While the former is eternal production of the forms of things, only the latter involves creation of matter and beginning of duration. Thomas, too, in his earlier writing, uses the vocabulary of 'creation' to describe the doctrine of the philosophers, and so distinguishes two meanings of the word. However, for him, the two meanings are: [1] doctrine of *total* dependence (some philosophers), and [2] that, plus the doctrine of beginning of duration (the Christian believer).

In his *Commentary on the Sentences* Thomas first establishes the existence of one sole first principle of all things. One of the lines of argument he uses for this presents the whole of reality as unified in function of the nature of entity existing in grades;

but the term 'creation' is not used.[18] However, in the very next discussion he asks whether something can proceed forth from that first principle by creation. He teaches 'not only does the Faith hold that there is creation, but reason also demonstrates it.'[19] He goes on to recall the just seen general line of argument based on gradation of beings as such and concluding that every thing, as regards the entirety of what is in it of being, has its origin in the first and perfect being. And he concludes: 'Now, this is what we call "creating", that is, bringing a thing into being, as regards the entirety of its substance'.[20]

Historically, a zealous opponent of the doctrine of creation was Averroes.[21] He ridiculed the idea of a 'making out of nothing', and asserted that all making requires a subject on which the maker works. In so speaking, he saw himself as agreeing with Aristotle's *Physics*. Averroes' first argument is that if to be 'made' is to be *changed*, and all change requires a subject (as Aristotle shows),[22] then everything made must be made out of some subject. Thus, it is not possible for something to be *made out of nothing*.

Thomas[23] replies as follows. Since indeed it is true, as Aristotle says, that movement requires a subject, what really follows is that the universal production of that-which-is [*productio universalis entis*] is *neither a movement nor a change*. Rather, it is a sort of simple emanation [*quaedam simplex emanatio*].[24] Thus, Thomas notes, such words as 'to be made' [*fieri*] and 'to make' [*facere*], when applied to this universal production of things, are said *equivocally*, as compared with their use regarding other productions.[25]

Thomas draws a conclusion that envelops two visions of the universal production, both philosophically sound. Just as, if we understand the production of things by God in such a way that they exist from all eternity, as did Aristotle and many Platonists,[26] still it is not necessary, indeed *it is impossible*, that any unproduced subject be understood as having priority vis-à-vis this universal production, so also, if we hold, in accordance with the judgment of our faith,[27] that God produced things *not* as existing from all eternity, but as after not having been, still it is not necessary to posit any subject for this universal production.

At this point Thomas puts the finishing touch on his rejection of Averroes' first argument. By now it should be clear that what Aristotle proves in *Physics* Book 8, viz. that every movement requires a movable subject, does not go against the judgment of the Christian faith, since the universal production of things, whether posited as from eternity or not from eternity, *is not a movement or a change*. The reason is that a movement or a change requires that *something* be constituted or situated otherwise now than it was before, and so requires that that *something* exist prior to the change. Thus, a change cannot be that universal production of things of which we are now speaking.

Thomas Aquinas was thus able to show that Averroes had misunderstood the doctrine of creation, and that such a doctrine, while not being considered by Aristotle in his *Physics*, was actually the doctrine of Aristotle's *Metaphysics*. In *Metaphysics* Book 2, Aristotle proves that that which is maximally true and maximally a being is the cause of being for all existing things [...*id quod est maxime verum et maxime ens, est cause essendi omnibus existentibus* ...].[28] Thus, Thomas argues, it follows that the very *being in potency* [... *hoc ipsum esse in potentia* ...] which primary matter has is derived from the first principle of being [... *a primo essendi principio* ...], which is the maximal being [*maxime ens*]. Thus, it is not necessary to presuppose something to its action, something not produced by it.[29]

Since creation is not a change, one cannot merely point to some event and claim to have encountered creation. If something becomes observable where previously nothing was observable, one has certainly at least a change, but one cannot be sure one has creation. *Nothing* is not an empirically verifiable object. One can only assert one's inability to discern.[30]

That being so, how can Thomas Aquinas assert that creation is demonstrably the case? The argument involves an interpretation of gradation. Gradation of a quality according to more and less indicates a causal origin. This, I would say, is the principle on which all investigation is based.[31] We might recall that 'investigation' comes from the Latin *vestigium* meaning a footprint, and that in hunting one judges proximity to the animal by the depth of the print in the soil: the deeper the print, the fresher the track. One should recall, also, for example, sonar devices by which one locates a submarine and its path of movement, on the basis of strong and weak signals.[32] Thomas's argument for creation is based on an experience of gradation in beings, considered precisely as having being according to more and less. Thus, a thing which lacks cognition has only its own being, while a thing which knows and understands has more ample being; indeed, 'is, in a way, all things', as Aristotle said.[33] In this line of thinking, inasmuch as even the knowing beings that we experience are clearly caused,[34] we are confronted with grades of being, indicating the existence of a cause of being as being, something beyond the sort of being we encounter.[35]

Obviously, this has nothing to do with things appearing or disappearing. It rather pertains to a purely intellectual appreciation of derivation. As the cause of being as being, the cause in question does not employ any matter or subject of change. Any such subject or matter, as pertaining itself to the being of things, is part of the produced field as such.

So also, the question of the duration of the product is strictly one of what the source, now viewed as producing things by intellect and will,[36] decides is appropriate.[37] It could be without temporal beginning or with temporal beginning.

Physics and Change

My general point is that there is a doctrine of creation that pertains to the faith of the Christian religion, and there is a metaphysical doctrine which coincides in part with that doctrine of faith, but that mathematico-physical cosmology is about something else. The reason I say that cosmology is about something else is that physics is about change and the changeable,[38] and creation is not a change.

Perhaps we should begin with a consideration from Aristotle's *Physics*, what some would call 'philosophy of nature'. Aristotle asked the following question at the beginning of Book 8:

> Was there ever a becoming of motion [*kinésis*] before which it had no being, and is it perishing again so as to leave nothing in motion? Or are we to say that it never had any becoming and is not perishing, but always was and always will be? Is it in fact an immortal never-failing property of things that are, a sort of life as it were of all naturally constituted things?[39]

He goes on to argue that motion must always have existed. His argument is that motion requires the existence of the movable thing. ('Motion' here applies to the various types of change: local change, alteration, and so on.) If the things themselves had to come into existence, that coming into existence would itself be a change, and thus one would have a change before the supposed first change. (Here, obviously, the only sort of 'coming into existence' Aristotle considers is a change, that is an instance of generation.) If the things already exist, both the movable and the thing having motive power, and nothing is happening, there will have to be a movement before the supposed first movement. We read:

> So if the motion was not always in process, it is clear that they must have been in a condition not such as to render them capable respectively of being moved and of causing motion, and one or other of them must have been in process of change: for in what is relative this is a necessary consequence: e.g., if one thing is double another when before it was not so, one or other of them, if not both, must have been in process of change. It follows, then, that there will be a process of change previous to the first.[40]

My point, here, is that physics, as the study of changeable things as such, cannot envisage an absolute beginning of change. If it encounters a change which has a beginning, its questions are as to what brought about that change, and why it was not already occurring. Invariably, it supposes that conditions were not quite right, and it inquires as to how they *became* right.

Of course, the metaphysician can envisage a cause of the existence of changeable things and their changes, and such a cause can be seen as able to cause such things as having a beginning of change. But that is not physics.

What the physicist (or anyone else) must not do is envision a 'change' from nothing to something. Consider the following paragraph from a report on current cosmology:

> Nevertheless, most cosmologists, including Dr. [Alan] Guth and Dr. [Andrei] Linde,[41] agree that the universe ultimately must come from somewhere, and that nothing is the leading candidate. As a result, another tune that cosmologists like to hum is quantum theory. According to Heisenberg's uncertainty principle, one of the pillars of this paradoxical world, empty space can never be considered *really* empty; subatomic particles can flit in and out of existence on energy borrowed from energy fields. Crazy as it sounds, the effects of these quantum fluctuations have been observed in atoms, and similar fluctuations during the inflation are thought to have produced the seeds around which today's galaxies were formed. Could the whole universe likewise be the result of a quantum fluctuation in some sort of primordial or eternal nothingness? Perhaps, as Dr. [Michael] Turner put it, 'Nothing is unstable'.[42]

The philosophical problems that plague ordinary quantum mechanics are amplified in so-called quantum cosmology. For example, as Dr. Linde points out, there is a chicken-and-egg problem. Which came first: the universe, or the law governing it? Or, as he asks, 'If there was no law, how did the universe appear?'[43]

Obviously, they do not really mean 'nothing'. At best, they would have to mean something in principle unobservable. Even then, as Linde's chicken–egg point makes clear, he is thinking of corporeal or material reality and the laws of its behaviour. Why should 'chaotic inflations' result in anything that might be called a 'world' or 'universe'?

In fact, we seem still to be in an eternal world picture (allowing 'world' to encompass even the sort of 'primordial or eternal nothingness' whose 'fluctuations' can be traced to its 'instability'), and *we still are looking for a* '*match*'! As the same report tells us:

> 'If inflation is the dynamite behind the Big Bang, we're still looking for the match,' said Dr. Michael Turner, a cosmologist at the University of Chicago. The only thing that all the experts agree on is that no idea works — yet. Dr. Turner likened cosmologists to jazz musicians collecting themes that sound good for a work in progress: 'You hear something and you say, oh yeah, we want that in the final piece.'[44]

In fact, we recently had a proposal from some string theorists for an even more deliberately eternal cosmic model. Paul Steinhardt of Princeton, along with Neil Turok of Cambridge, have proposed a new string-theory-based cyclical model. The BBC quotes Steinhardt as follows:

> In the standard picture, it's presumed that the Big Bang is actually a beginning of space and time; that there was nothingness, and then suddenly out of nothingness there sprang space, time, matter, radiation, et cetera.
>
> What we're proposing in this new picture is that the Big Bang is not a beginning of time but really just the latest in an infinite series of cycles, in which the Universe has gone through periods of heating, expanding, cooling, stagnating, emptying, and then re-expanding again.[45]

However, according to the periodical *Nature*, Linde has been scathing in his criticism:

> 'It's a very bad idea popular only among journalists,' says one of the chief critics of the cyclical model, Andrei Linde of Stanford University, California. 'It's an extremely complicated theory and simply doesn't work,' adds Linde, the originator of a rival model of the Universe.[46]

My point is merely that it is no surprise that this kind of solution is sought.[47]

Of course, there may be people out there who do not mind things 'leaping' from nothing into being.[48] I think it is clear that nothing does not leap. Nor is it, *pace* Michael Turner, unstable.

To return to more accepted science, even the Standard Hot Big Model starts, not from nothing, but from a singularity described as having 'infinite density' and 'infinite temperature'. As Professor David Harrison of the University of Toronto tells us:

> … the moment of the Big Bang itself presents problems for physicists. The problem is that the language that we use to describe the universe, i.e. mathematics, breaks down when things become zero (the size of the universe) and infinite (the temperature and density). These conditions are called singularities. The mathematics works fine for any time after the Big Bang but not for moment of the bang itself.[49]

Notice that he begins with 'the universe', but as having zero size.[50]

In short, the physicists seem to conform to the Aristotelian contention that one start with changeable things and things apt to produce change ('dynamite' and a

'match'), and it seems reasonable to contend that before any supposed first event, one is obliged to seek a prior.

Physics and New Models

This brings me to a scenario envisaged many years ago by Charles De Koninck.[51] He distinguished sharply between 'the disciplines', by which he meant the philosophical sciences knowing things *with certainty* in the light of their causes, and experimental science, which arrives only at probabilities, because of the very nature of its procedure. I am interested in his sizing-up of experimental science and the sorts of 'law' it can provide. We are cautioned lest we overrate the certitude of the discoveries (fascinating and important though they are) of current physics and cosmology.

To me the most important point he makes concerns the impossibility of having experimental knowledge of true determinism (if it existed in nature). We read, first:

> From the viewpoint of scientific methodology, the important issue is that even if there were determinism in nature, the scientist could never define it *experimentally*. Such a definition could only be based on an incompossible infinite multitude of experiments.[52]

He then proposes a fascinating scenario:

> Let us imagine an intelligence contemplating a finite spatio – temporal universe from beginning to end. This is an ideal case for complete observation. Finally, when '*la farce est jouée*', our super-physicist establishes that all phenomena have taken place with perfect regularity and have inserted themselves in the differential equation suggested at the very outset. Could he therefrom deduct [*sic*, read 'deduce'] that this universe was governed by deterministic laws of governance? He probably would if he had no imagination. But if he is really trying to *explain* what has happened, and not just talk natural history, then he shall show, by imagining a large number of other possibilities, that the present development was merely a highly probable one, and that it has in fact occurred. If he desired to prove that this was the only possible case, then he would have recourse to philosophy. But there he would learn about objective margins of indetermination.[53]

It seems to me that this is exactly what we are getting in the discussions of expanding universes. Imaginations are coming forth with all sorts of scenarios,[54] in which the Bang seems no longer to be unique, singularities disappear, and so on.

His point seems to be that experimental science *as experimental* is too much the observation of particular sensible things as such to announce a true universal. It merely recounts a history, which can be explained in many ways.

Conclusion

When the Big Bang theory first appeared on the scene, it was taken by some (I think of Sir Edmund Whittaker) as pointing in a most convincing way to the religious doctrine of creation with a temporal beginning.[55] This view has been recently maintained by some (I think of William Lane Craig).[56] Jacques Maritain, as I noted at the outset, linked

the theory with the doctrine of temporal creation rather merely as a more favourable frame for our imagination. This, I would say, is the correct judgment.

The cosmologists, living in a culture heavily formed by the religious doctrine of creation, have yielded to the temptation of describing their models in terms of 'nothing' and 'creation'. This, I suggest, is good neither for physics nor for metaphysics nor for religion. I close with a quotation from J.V. Peach, writing in 1962:

> The problem of the 'age of the universe' has been looked upon by some in the past as a field in which a scientist could perhaps confirm or contradict a theologian's view as to the fact of Creation in time. This was an illusion. What a scientist can in fact do is far less grand, but nevertheless exciting. Estimates of ages of parts of the universe are now an essential part of the science of cosmology, and form a body of established facts that cosmological theory must take into account. It was an unfortunate confusion that led to a more exalted view of their importance.[57]

Notes

1 Jacques Maritain, *Approches de Dieu* (Paris: Alsatia, 1953), pp. 51–2, italics his (my translation); cf. *Approaches to God*, trans. Peter O'Reilly (New York: Collier Books, 1962), pp. 46–7. In *Approches de Dieu*, Maritain had noted that St Thomas rejects the possibility of demonstrating the non-eternity of the world on the grounds that truly demonstrative arguments bear upon the intelligible structures of things (which are universal and necessary) and not on singulars and contingents; he went on to add that one could not use the observational way of straight history to discover the beginning. He then made the quoted statement.

2 Cf. Donald Cancienne, 'The Age of the Universe', *Laval théologique et philosophique*, 24 (1968):9–38. This is an excellent presentation of the idea of models of the universe, together with a presentation of their variety in 1968.

3 Dennis Overbye, 'Peering through the Gates of Time', *New York Times* [byline: Princeton, N.J., 5 March 2002]: John Archibald Wheeler, professor emeritus of physics at Princeton and the University of Texas, and now aged 90, is quoted as follows: 'The time left for me on earth is limited … And *the creation question* is so formidable that I can hardly hope to answer it in the time left to me. But each Tuesday and Thursday I will put down the best response that I can, imagining that I am under torture.' [my italics]
In the same article we read:
Dr. Wheeler suspects that … quantum uncertainty… is the key to understanding *why anything exists at all, how something, the universe with its laws, can come from nothing*. Or as he likes to put it in the phrase that he has adopted as his mantra: 'How come the quantum? How come existence?' [my italics]
Nor is God left out of the picture; we read:
Across the hall was a lounge with rows of windows, leather couches and a fireplace with an inscription from Einstein on the mantelpiece. 'Raffiniert ist der Herr Gott, aber Boshaft ist er nicht,' Dr. Wheeler said, reading. Then he translated, roughly, 'God is clever, but he's not malicious.' Asked if he agreed, Dr. Wheeler nodded, then pumped his fist in affirmation. Back in his office Dr.

Wheeler busied himself at the blackboard with a diagram that is emblematic of quantum weirdness [viz. the double slit experiment], and of his hope for *constructing the universe and its laws 'higgledy-piggledy,' as he likes to call it, out of nothing*. [my italics.]

Nevertheless, a few weeks later, regarding a Plainsboro, N.J. gathering in Wheeler's honour, and entitled 'Science and Ultimate Reality' [cf. Dennis Overbye, 'Discussing the Nature of Reality, Between Buffets', *New York Times,* 26 March 2002], it was found necessary to note:

The prime sponsor was the John Templeton Foundation, best known for its annual $1 million prize for 'progress in religion'. The foundation also supports basic scientific research into the nature of reality, and it is under that mission that the Wheeler meeting was conceived, said Dr. Charles Harper, Templeton's executive director and a former planetary scientist.

Dr. Harper said he had hoped to hold the conference at Princeton in partnership with the physics department, but 'some people were suspicious'. Dr. James Peebles, a recently retired Princeton cosmologist, said there was a general feeling that '*we don't do religion*'. Dr. Paul Steinhardt, a Princeton cosmologist, elaborated: 'They were doing their thing in their style. We would do our thing in our style.' And Princeton, he noted, had already celebrated Dr. Wheeler's actual 90th birthday last July and had a larger celebration in the works. *Dr. Wheeler said he had been adamant that there be no religion on the agenda.* [my italics]

Thus, we see that God, in some sense, is welcome, and creation too, but not 'religion'.

4 William Lane Craig, 'God and the Initial Cosmological Singularity: A Reply to Quentin Smith', *Faith and Philosophy*, 9 (1992): 238–48; he is replying to Quentin Smith, 'A Big Bang Cosmological Argument for God's Nonexistence', *Faith and Philosophy*, 9 (1992): 217–37.

5 This work, a resume of another written about 160 B.C., is probably from around 124; cf. *Bible de Jérusalem*, (ed.) 1973, p. 582. *The Holy Bible: Revised Standard Version, Ecumenical Edition* (New York: Collins, 1973), translates the original Greek accurately:I beseech you, my child, to look at the heaven and the earth and see everything that is in them, and recognize that God did not make them out of things that existed.

6 The *Bible de Jérusalem* notes that the biblical authors were insisting on the 'historical' character of the event described: they were rejecting the 'a-temporal myth' type of presentation (cf. the note on verse 2.4a as well as that on verse 1.1).

7 Gerhard May, *Creatio ex nihilo: the doctrine of 'Creation out of Nothing' in Early Christian Thought*, trans. A.S. Worrall (Edinburgh: T & T Clark, 1994) (authorized English translation of *Schöpfung aus dem Nichts. Die Entstehung der Lehre von der creatio ex nihilo*, first published in 1978).

8 Born in Assyria ca. 120 A.D. Studied under Justin Martyr. Concerning his *Address to the Greeks*, written before 171, cf. Etienne Gilson, *History of Christian Philosophy in the Middle Ages* (New York: Random House, 1955), p. 557.

9 Cf. Gilson, *History of Christian Philosophy in the Middle Ages*, p. 560: Theophilus was bishop of Antioch in 169. His only surviving work, the apology *To Autolycus* in three books, dates from about 181. Gilson (pp. 19–20) tells us:
Like his predecessors, Theophilus starts from the faith in one God, creator of heaven and earth, orderer of the universe which he rules by his providence, and lawgiver who prescribes to men both justice and piety. His personal contribution to this already established tradition is his effort to define accurately the notion of creation. Although the notion itself seems to have been clear in the minds of Justin and of Athenagoras, the vagueness of their formulas authorizes some hesitation as to their exact meaning. On the contrary, Theophilus is quite clear on this point. By saying that God has made man, he means to say that God has made man out of slime, which itself was nothing before it had been made by God. *Both the notion and the formula of creation ex nihilo are there, and, for the first time, in words which preclude all hesitation on the meaning of the doctrine.* Theophilus emphasizes that this production of the very being of things is what makes creation different from the work of an artisan shaping things out of some pre-existing matter. The fact that Theophilus reproaches Plato for having taught the eternity of matter clearly shows that he is opposing the doctrine of the *Timaeus*. The God of Theophilus is not a Greek 'maker' of the world; he is its creator. [my italics].

10 Cf. Gilson, *History of Christian Philosophy in the Middle Ages*, p. 561: born *c*.126 in or near Smyrna (Asia Minor); was a priest of Lyons and eventually bishop there. He teaches that the world was created out of nothing and by a free act of the divine will; it has no other cause than the goodness of God: it has sprung forth from the generosity of its creator (Gilson, p. 23, with references at p. 562).

11 Cf. May, pp. 166–78.

12 Albert was a Master at Paris from 1245 to 1248, when he was sent to Cologne. Thomas began studying with him in Paris, and continued in Cologne until 1252. We possess the autograph manuscript from Thomas of Albert's lectures on the works of the pseudo-Dionysius, seemingly begun in Paris and completed in Cologne. Cf. Jean-Pierre Torrell, O.P., *Initiation à saint Thomas d'Aquin (Sa personne et son œuvre)* (Fribourg, Suisse and Paris: Éditions Universitaires de Fribourg / Cerf, 1993), p. 38 and pp. 31–3.

13 Albertus Magnus, *Super Dionysium De divinis nominibus*, Paul Simon (ed.), in *Opera omnia*, t. 37/1, Münster, 1973: Aschendorff, *(c*.1248, with Thomas as student-secretary):
Secundum hoc autem, cum exitus rerum a primo sit tantum formalis, sicut luminis a luce prima, quasi agentis ex necessitate suae formae, non inveniretur modus, quo procederet materia ab ipso; unde oporteret ponere materiam aeternam, quod est contra fidem. Et ideo sequimur opinionem Aristotelis, quae magis videtur catholica… (p. 73, lines 35–42)
On the views of Albert the Great on this issue throughout his long career, see my paper, 'St. Albert, Creation, and the Philosophers', *Laval théologique et philosophique*, 40 (1984): 295–307. He understands the philosophers as always presupposing the existence of matter.

14 Thus, to an objector who points out that in the *Metaphysics* the first cause moves as an object of desire, and argues that this presupposes the existence of something which desires, and so one must suppose at least matter as eternal, he answers that the coming forth of matter from God:
… cannot be investigated by natural theorizing; and so Aristotle said that matter is ingenerable and indestructible.… [*non potest investigari per rationes naturales; et ideo dixit Aristoteles materiam esse ingenitam et incorruptibilem*…] (p. 74, lines 41–43).

15 Thomas Aquinas will see in this doctrine of Avicenna's a misconception of the being of the forms of material things: it accords them 'being' as if they were subsisting things, i.e. things having a being of their own, rather than merely being the formal part of a material composite; cf. *Summa theologiae* [henceforth '*ST*'] 1.45.8 ((ed.) Ottawa, 292a30–45), and 1.65.4.

16 Albertus Magnus, *Super Dionysium De divinis nominibus* ...:
… deus quidem est agens perfectum et potest educere totam rem in esse, sed ista non compatiuntur se, quod aliquid sit eductum in esse secundum totam suam substantiam, scilicet secundum materiam et formam, et sit ab aeterno, quia talis creatio de necessitate ponit principium durationis, quamvis creatio, de qua loquitur Avicenna, quae est tantum formarum, possit intelligi ab aeterno. (p. 118, lines 75–83).

17 Thomas Aquinas, *Scriptum super libros* Sententiarum *magistri Petri Lombardi*, 2.1. *expositio textus*, P. Mandonnet (ed.) (Paris: Lethielleux, 1929), t. II p. 43 [henceforth '*Scriptum*']:
Aristotle did not err by positing several principles: because he posited that the being of all depends solely from the first principle; and so the conclusion is that the first principle is one. He did however err in positing the eternity of the world.
... [A]ccording to him, the first efficient principle and the ultimate end are reduced to the same numerically one thing, as is clear in *Metaph*. 12 (t.c. 37): where he posits that the first moving principle brings movement about as an object desired by all. But the form which is part of the thing is not posited by him as being numerically identical with the agent, but as identical as to species or likeness: from which it follows that there is one first principle outside the thing [caused], which [principle] is the agent and the exemplar [cause] and the end; and [there are] two which are parts of the thing, viz. the form and the matter, *which are produced by that first principle*.
This work of Thomas, reflecting his Parisian lectures given in order to qualify as a Master, is generally dated 1252–56: cf. James A. Weisheipl, O.P., *Friar Thomas d'Aquino* (Garden City, NY: Doubleday, 1974), pp. 358–9. Concerning the role of the *Sentences* of Peter Lombard in thirteenth-century theological education, cf. Weisheipl, pp. 67–76.

18 Thomas, *Scriptum* 2.1.1.1 (Mandonnet (ed.), pp. 12–13).

19 Thomas, *Scriptum* 2.1.1.2 (Mandonnet (ed.), p. 17).

20 Thomas, *Scriptum* 2.1.1.2 (Mandonnet (ed.), p. 18). Notice that the basic statement Thomas proposes as to what is meant by 'creation' uses production

of 'total substance' [*producere rem in esse secundum totam suam substantiam*] rather than the 'make out of nothing' formula.

21 Cf. Averroes, *In Phys*. 8.4 (Venice (ed.), 1562, t. IV, fol. 341r, C–F). He speaks of those whom he is criticizing as the 'loquentes ... Saraceni', i.e. the Moslem theologians.

22 *Physics*, 8.1 (251a9–17).

23 On many occasions, but in most detail in *In octo libros Physicorum Aristotelis expositio*, M. Maggiòlo, O.P. (ed.) (Rome/Turin: Marietti,, 1954), Bk. 8, lect. 2, 973 [3]–975 [5] (which I am following here).

24 Cf. Thomas's formula for creation at *ST* 1.45.1 (283b53–284a5):
… it is necessary to consider not only the emanation of some particular being from some particular agent, but also the emanation of the whole of being [*totius entis*] from the universal cause, which is God; and this emanation we designate by the word 'creation'.

25 The shortcomings of such words as 'make' and 'be made' as descriptions of creation are clearly explained in the following text (*ST* 1.45.2.ad 2):
... creation is not a change [*mutatio*], save only according to the understanding's approach to it [*secundum modum intelligendi tantum*].
For it belongs to the nature [*ratione*] of change that *something identical stand otherwise now than previously*: for sometimes it is the same being in act [*ens actu*], standing otherwise now than before, as in the case of changes [*motibus*] as to quality and quantity; but sometimes it is the same being in potency only [*ens in potentia tantum*], as in change as to substance, the subject of which [change] is matter.
But in creation, by which the *entire* substance of things [*tota substantia rerum*] is produced, one cannot take anything as the same, standing otherwise now than previously, save according to notion only [*secundum intellectum tantum*]; as, for example, if one understand *something* [1] previously totally not to have been, and [2] subsequently to be.
But since 'action and passion agree in the substance of motion', and differ only in function of the diverse stances [*habitudines*], as is said in *Physics* 3 [202b20], it is necessary that, motion being eliminated, there remain only the diverse *relations* in the one creating and in the thing created.
But because the mode of signifying follows upon the understanding's approach [*modum intelligendi*], as has been said [q. 13, a. 1], creation is *signified* as though it were a change [*per modum mutationis*]; and because of that, it is said that 'to create is to make something out of nothing'.
Still, 'to make' [*facere*] and 'to be made' [*fieri*] are more suitable for the [discussion] than 'to change' and 'to be changed', because 'to make' and 'to be made' signify the relation [*habitudinem*] of the cause to the effect, and of the effect to the cause, but [signify] change only as a consequence.

26 Thomas does not name Plato himself here. This could well be, not because he does not attribute a doctrine of creation to Plato, but because he is not sure about Plato and the issue of temporal beginning. Or it may be because he wants to include Plato and his followers in a single word.

27 For Thomas's view of the faith in this matter, cf. *ST* 1.61.2:

It is to be said that God *alone*, Father and Son and Holy Spirit, has being from eternity. For this the Catholic Faith indubitably holds, and everything to the contrary is to be refuted as heretical. For it is in this way that God produced creatures, that He made them *from* nothing, that is to say, *after* nothing had being. [italics mine]

Thomas is insisting, as the Latin shows: '... eas *ex* nihilo fecit, *idest postquam* nihil fuerit'. Of course, the 'after' does not mean that there was *real* time before the creature was made; as Thomas elsewhere (*ST* 1.46.1.*ad* 8) explains:

[In the expression: 'before the world...', the term 'before'] designates an eternity of *imagined* time, not *really existent* time. Just as when one says: 'beyond the universe, there is nothing', the word 'beyond' designates a merely imagined place, according as it is possible to add on further dimensions to the observed extent of the universe of bodies.

Concerning the temporal beginning of the universe as Catholic dogma, and a very skilful summary of science–theology relations, see William A. Wallace, 'Aquinas on Creation: Science, Theology, and Matters of Fact,' *Thomist* 38 (1974): 485–523.

28 Thomas has in mind Aristotle, *Metaphysics*, 2.1 (993b19–31), where Aristotle presents the first causes, which are maximally being, as the causes even of eternal things; cf. Thomas's *In Metaph*., 2.2 (289–98).

29 Thomas, *In Phys*., 8.2 (974 [4]).

30 Averroes had actually attempted to explain the adherence to a doctrine of creation by believers, saying that the common people regard as *existent* only those things which can be seen; hence, because the common man sees something made visible which previously was not visible, he thinks that it is possible that something be made from nothing. Thomas rejects this allegation: it is not because we [Christians] think only visible things are beings. On the contrary, it is because we do not consider merely the particular productions of particular causes, but also the universal production of the entirety of existence by the first principle of existence.

31 Thus we have the premise in Thomas's Fourth Way, i.e. *ST* 1.2.3 (14b20–24):

The 'more' and the 'less' are said of diverse things inasmuch as they approach in diverse degrees to that which is 'most': as, for example, that is more hot which approaches more that which is hottest.

32 As Thomas says in *Summa contra gentiles* [henceforth '*SCG*'] 3.64 (#2391):

... To the extent that something is closer to the cause, to that extent it participates more in its effect. Hence, if something is all the more perfectly participated by some things the closer they get to some thing, this is a sign that that thing is the cause of that which is participated in diverse degrees: as, for example, if some things are warmer the closer they are to a fire, this is a sign that the fire is the cause of the warmth.

33 Aristotle, *De anima*, 3.8 (431b21). For the ampler nature of the being which knows, as contrasted with the being which does not know, cf. *ST* 1.14.1 (and explicitly in terms of modes or measures of being, *ST* 1.12.4); cf. also *SCG* 3.112 (Pera (ed.), #2860); also *In De anima*, 2.5 (Leonine lines 43 ff.) on modes of being.

34 Cf. *ST* 1.79.4.

35 Cf. my paper: 'St. Thomas, the Fourth Way, and Creation', *The Thomist*, 59 (1995): 371–8.

36 Cf. *ST* 1.19.4.

37 *SCG* 2.35, in its entirety, is extremely helpful; also 2.38 (1149).

38 When one says that physics is about change, one does not exclude its considering states of rest or immobility, where it is the immobility of what is by nature mobile or changeable that is meant. On the other hand, when one says that God is unqualifiedly immobile, this means that God transcends change and abstention from change altogether: cf. *ST* 1.9.1 and 2; knowledge of such a being pertains to metaphysics.

39 Aristotle, *Physics*, 8.1 (250b11–14); Oxford tr. R.P. Hardie and R.K. Gaye.

40 Ibid. 251b5–10.

41 Even Andrei Linde's 'eternal inflation' theory actually involves some sort of 'beginning' of the developed universe or series of universes. In the Overbye article (22 May 2001) to which I refer below, we are told of Guth's attempt to make the Higgs field the *agent* for cosmic inflation; and we read:

Subsequent calculations ruled out the Higgs field as *the inflating agent*, but there are other inflation candidates that would have the same effect. More important, from the pre-Big-Bang perspective, Dr. Linde concluded, one inflationary bubble would sprout another, which in turn would sprout even more. In effect each bubble would be a new big bang, a new universe with different characteristics and perhaps even different dimensions. Our universe would merely be one of them. '*If it starts*, this process can keep happening forever,' Dr. Linde explained. 'It can happen now, in some part of the universe.' The greater universe envisioned by eternal inflation is so unimaginably large, chaotic and diverse that *the question of a beginning to the whole shebang* becomes *almost*[!] *irrelevant*. For cosmologists like Dr. Guth and Dr. Linde, that is in fact the theory's lure. '*Chaotic inflation allows us to explain our world without making such assumptions as the simultaneous creation of the whole universe from nothing*,' Dr. Linde said in an e-mail message.

What interests me here are: [1] the search for an agent, and [2] the fact that they have not really abandoned a beginning. They have merely looked for a nice big explosion to allow use of the very small to account for the very big.

42 Cf. the following item:

GUTs: Quantum Foam: The difficulty with merging general relativity and quantum mechanics arises from quantum energy fluctuations. Quantum mechanics says that even the gravitational field is effected by these fluctuations. General relativity states that there is a zero gravitational field in empty space, but quantum mechanics say it averages zero, and fluctuates more and more wildly on a smaller and smaller scale. According to quantum mechanics, if you could magnify empty space enough, you would find that it is not flat at all but tangled, distorted, bubbly, and tumultuous. This frenzy is called quantum foam. The equations of general relativity can't handle quantum foam, even though quantum foam is only visible when you magnify to smaller than the Planck length or 10^{-33} cm. This makes it extremely difficult to unite the general relativity theory with quantum mechanics.

[This is from the website 'ThinkQuest.org,' and their 'GUTs of the universe' page; which relates to 'General Unified Theory'.]

An article by Malcolm W. Browne concerned an experiment performed by Dr. Steve K. Lamoureaux and recently described in *Physical Review Letters*. The results 'almost perfectly matched theoretical predictions based on quantum electrodynamics, a theory that touches on many of the riddles of existence and on the origin and fate of the universe' (*New York Times*, Tuesday, 21 January 1997, p. C1). The article is headed 'Physicists Confirm Power of Nothing in Foam', and subtitled 'Fluctuations in the vacuum are the universal pulse of existence'. However, the very first thing we are told is that we have not to do with 'nothing'. We read:

For a half century, physicists have known that there is no such thing as absolute nothingness, and that the vacuum of empty space, devoid of even a single atom of matter, seethes with subtle activity. Now, with the help of a pair of metal plates and a fine wire, a scientist has directly measured the force exerted by fleeting fluctuations in the vacuum that pace the universal pulse of existence. (ibid.)

Nevertheless, a box inset on p. C6 is entitled 'The Shape of Nothing', and we have a visualization of the foam of erupting and collapsing virtual particles; the visualization is described as 'a topographical distortion of the fabric of space–time.'

43 Dennis Overbye, 'Before the Big Bang, There Was ... What?,' *New York Times*, 22 May 2001.

44 As is clear, the 'dynamite and match' imagery follows exactly the scenario posited by Aristotle, as quoted above, at n. 39: the dynamite is changeable, and the match is a source of that change; but such a scenario presupposes the *application* of the match to the dynamite, a physical event *before* a bang.

45 The BBC News, Thursday, 25 April 2002, 'Universe in "endless cycle"'.

46 Tom Clarke, 'Big Bang Sparks Row: Cosmologists claim Universe has been forming and reforming for eternity', *Nature*, 'Science Update', 26 April 2002.

47 In January 2003 I received notice of a meeting of the American Association for the Advancement of Science 'Program of Dialogue on Science, Ethics, and Religion' to listen to papers by Steinhardt and Professor Francesca Cho of Georgetown University, entitled 'Before the Beginning .... The Return of the Cyclic Universe' (16 January 2003). Speaking of their model and the Standard Big Bang model, Steinhardt and Turok say: 'It is anticipated that it will be possible to test these two models empirically.'

48 Quentin Smith has an article on the website of The Royal Institute of Philosophy in which he proposes that the universe can 'cause itself to begin to exist': 'The Reason the Universe Exists is that it Caused Itself to Exist.' I would say that he is supposing the same thing, as regards precisely the same perfection, both to be, so as to cause, and not to be, so as to require a cause. However, even such a position does not merely assert that an item properly named 'nothing' is playing the role of cause or source.

49 David M. Harrison, 'The Standard Hot Big Bang Model of the Universe', February 2001 (version 1.3, date (m/d/y) 01/13/02), Website of Department of Physics, University of Toronto. In a paper dating from 1981, 'Infinity in

Physics and Cosmology' (*Proceedings of the American Catholic Philosophical Association*, 55 (1981): 59–72), Charles Misner (at present Senior Research Scientist and Professor Emeritus of Physics, University of Maryland) opined that the philosopher ought to interpret the Standard Hot Big Bang model as presenting a universe with an eternal past. He says:

My viewpoint is that proper time, as computed above, is not the right thing for a philosopher to use in assessing the finiteness of the age of the universe. It is the right thing for a physicist to use in calculating reactions rates, because these refer to phenomena on a small scale where spacetime is not significantly curved and special relativity (where proper time was fundamentally defined) applies. But the question 'Is the universe infinitely old?' outruns the language in which it is phrased. It assumes there is a natural, well-understood meaning and measure for time. But this is not the case near the initial singularity where even the well established and highly technical definitions such as proper time have limited applicability because of their origins in flat spacetime theories. *The philosopher should, for a significant answer to this question, direct his attention to the real things that are to have occurred in the early universe*. He should not measure in terms of imaginary earth orbits (infused via the normalization factors for quark orbit times, etc.) applied to an epoch where no earth could have existed. If one ignores all these mathematical renormalizations, and simply counts the *physical phenomena that are to have happened at earlier stages* in plausible models, then he can reasonably imagine that *the past contains an infinite number of realized distinct phenomena*. Allowing for all the cultural baggage that accompanies the word 'time' when it appears in a philosopher's question about the age of the universe, I would choose the statement that an infinite number of events have occurred in the past as a more apt reply, than is the statement that the computed proper time back to the singularity is finite. Thus I would choose to say that *the universe seems to be infinitely old* in reasonable interpretations of the standard hot big bang model universe. (71–2, my italics)

50 So also, back in 1976, consider some of the things said by J. Richard Gott (with others) in an article: 'Will the Universe Expand Forever?' (*Scientific American*, March 1976). He says: '... at some unique time in the past all the matter in the universe was compressed to an arbitrarily *great* density ...' Then we read: '... crushed together at *infinite* density'. Then, '... the initial state is one of ... *high* density...' We alternate between the 'high' or 'great' (which sounds measurable) and the 'infinite'. So also, though we were told that 'matter was compressed', we are also told that 'space and time were *created* in that event *and so was all the matter in the universe*' (matter seems to have to *be*, in order to be infinitely dense, and *not to be*, in order to result from the bang. We are also told: 'The point–universe was not an object isolated in space; it was the entire universe ...' Thus, the universe was a 'point'. Quite aside from the fact that the universe seems to be present both at the origin of the creative event and at its achievement, the notion of a point taken all by itself is rather purely mathematical. Is the move from density to rarity, or from no dimensions to dimensionality?

51 Charles Decruydt De Koninck, 'Thomism and Scientific Indeterminism', in *Proceedings of the American Catholic Philosophical Association* (for 1936) (Washington: Catholic University of America Press, 1937): 58–76.
52 De Koninck, p. 68.
53 De Koninck, p. 69, his italics.
54 Cf. e.g. Philip Ball, 'New model of expanding Universe: There are more than two ways to pump up the Universe', *Nature* News Service, 2 February 2001 (concerning the proposal by Leonard Parker and Alpan Raval of a model which omits the Einstein fudge factor, and, like the 'quintessence' model, proposes a new sort of energy field pervading all space, but one which affects only gravitational forces between objects); cf. also, in the above-mentioned article by Overbye ('Before the Big Bang …'), we are told of a string-theory model by Paul Steinhardt and others, called the 'ekpyrotic universe', one revised by Linde and others and called the 'pyrotechnic universe' (neither to be confused with the Steinhardt–Turok cyclical model mentioned earlier).
55 Cf. Cancienne, pp. 28–9.
56 Cf. above, n. 4.
57 J.V. Peach, S.J., 'The Age of the Universe', *Heythrop Journal*, 3 (1962): 111–25, at 125 (quoted by Cancienne at p. 38).

Chapter 6

Cosmological Theories and the Question of the Existence of a Creator

John L. Bell

In the words of G.K. Chesterton, 'The Cosmos is about the smallest hole that a man can hide his head in.' And indeed, when engaged in cosmological speculation, one's mind seems to expand to encompass the universe. As Lev Landau observed: 'Cosmologists are often in error, but never in doubt.'

Since the dawn of civilization, the question of the origin of the universe has exercised human thinking. In one early Egyptian creation myth, for example, we are told how the sun god Ra conjured up the world from Nu, the swirling watery chaos:

> Heaven and Earth did not exist. And the things of the earth did not exist. I raised ... them out of Nu, from their passive state. I have made things out of that which I have already made, and they came from my mouth.

In a Vedic hymn, Reality or Being is proclaimed as having 'arisen from Nothing'. By contrast, in Jaina cosmology time has no beginning; the universe, uncreated, has always existed. In Plato's *Timaeus* the universe is conceived as not having existed eternally, but as having been created at some past time by a demiurge acting on pre-existing substance. We are all familiar with the arresting first line of Genesis: 'In the beginning God created the heaven and the earth.' Augustine took this to mean that nothing whatsoever existed before its creation by God, that God created the world – space, time, substance – *ex nihilo.*

In Newtonian cosmology, space, time and, perhaps, matter also have always existed; but at some point in the past God acted to introduce order into the universe. Newtonian cosmology was essentially static; the universe was not conceived, in the large, as having a history: while God may have intervened at some past time, the moment of intervention could be placed indefinitely far back. In the Newtonian scheme, moreover, space and time themselves, were, like God, sempiternal, and so not subject to the problem of origin. Thus the origin of the universe could be consigned to 'minus infinity' and the question safely ignored.

Einstein retained this changeless conception of the universe when he first applied general relativity to the problem of cosmic structure. Indeed he went so far as to introduce a force of 'cosmic repulsion' into his mathematical models, when he found that, in the absence of such a force, his equations had no solutions corresponding to a static universe with a uniform non-zero matter distribution. He later remarked that the assumption of changelessness seemed unavoidable to him because 'one would get into bottomless speculations if one departed from it'.[1] With hindsight, one can see how right he was!

In the 1920s the static view of the universe was shaken by two discoveries, one theoretical, the other empirical. In 1922 the Russian mathematician Alexander Friedmann, and, independently, the Belgian cleric Georges Lemaître in 1927 showed that Einstein's equations have non-static solutions with uniform matter distribution, corresponding to a continually expanding universe. Lemaître suggested that the universe had evolved by expansion from an initial highly compressed and extremely hot state, which he called the 'primeval atom' – the first explicit formulation of what later came to be known as the 'Big Bang'. In 1929 Edwin Hubble, in apparent ignorance of Friedmann and Lemaître's theoretical results, found the first evidence of such an expansion, observing a red shift in the spectrum of galaxies in direct proportion to their distance from us. Hubble's observations seemed at first to indicate that the expansion of the universe had begun only a billion or so years ago, contradicting the evidence from radioactivity in rocks that the earth's crust must be at least 5 billion years old. Happily, this conflict was resolved by a later revision of the distance yardstick based on stellar luminosity, which resulted in the origin of the expansion being pushed back to a point some 15 billion years in the past.

Thus did theoretical physics and observational astronomy together contrive to put the 'bottomless speculations' concerning the origin of the universe firmly back on the agenda. That science seemed to support the idea that the universe had an origin of some kind naturally appealed to cosmologists of a Christian persuasion, among whom E.T. Whittaker and E.A. Milne were prominent. Whittaker held that God created the universe from nothing:

> When the development of the system of the world is traced backwards by the light of laws of nature, we arrive finally at a moment when that development begins. This is the ultimate point of physical science, the farthest glimpse that we can obtain of the material universe by our natural faculties. There is no ground for supposing that matter ... existed before this in an inert condition, and was in some way galvanized into activity at a certain instant: for what could have determined this instant rather than all the other instants of past eternity? It is simpler to postulate a creation ex nihilo, an operation of Divine will to constitute Nature from nothingness.[2]

In 1951 Pope Pius XII cited Whittaker's assertion of the consonance between the Christian tradition and the picture of the expanding universe as providing scientific evidence for the Catholic world view.

Cosmologists of an agnostic turn of mind – a majority, I would surmise – were understandably disturbed that their discoveries could be used, plausibly or not, as a prop for traditional theology. In particular the 'Big Bang' scenario, by postulating a 'beginning' to the existence of the universe, seemed to offer new and alarming support for the venerable cosmological argument for God's existence. This argument traditionally assumes the following form: (i) whatever begins to exist is caused to exist by something else; (ii) the universe began to exist; (iii) therefore, the universe was caused to exist, and the cause of its existence is (called) God.

Anxious to avoid entanglement in such scholastic disputes, many physicists welcomed the formulation of the 'steady-state' theory of the universe in 1948 by Bondi, Gold and Hoyle. This provided an alternative to the 'Big Bang' scenario – a term introduced with derisory intent by Hoyle in 1950, which ironically caught on

– according to which the universe apparently sprang into existence from nothing and then expanded, continually cooling and attenuating, into its present quiescent state. In the steady-state theory, by contrast, it is denied that the universe is any cooler or less dense at present than it was in the past, denied in fact that any change in the large-scale structure of the universe has occurred over time, and, a fortiori – most importantly from a philosophical standpoint – denied that there was ever a time at which the universe has not existed. These assertions were based on the 'Perfect Cosmological Principle', the thesis enunciated by Bondi and Gold to the effect that the universe is not only similar from place to place but also from time to time. (The purely spatial version of this – the so-called 'Cosmological Principle' – had been used extensively by the proponents of the evolving universe.) On the face of it this thesis seems to conflict with the observed expansion of the universe. And in fact the only way of preserving a changeless universe in the presence of such expansion is to postulate, as did the 'steady statesmen', a continual steady creation of matter at precisely the rate required to offset the attenuation brought about by the expansion.

For me, a vivid illustration of the steady-state theory is provided by the 'Flying through Space' screensaver with which my computer is equipped. Here one sees, on a dark background, a continuous flow of 'stars' radiating outward from the centre of the screen. This is intended to represent, as its name implies, the viewpoint of an observer moving rapidly through interstellar space, encountering 'stars' that are already 'in existence'. But equally one may view the picture from the standpoint of an observer supposed stationary, in which case the 'stars' must be taken as continually springing into being and receding outwards. Despite the continual emergence of new 'stars', the law of conservation of mass (or energy) is observed 'locally' in the sense that the total number of such 'stars' on the screen does not change with time. This is, *mutatis mutandis*, the scenario of the steady-state theory.

In order to compensate for the universe's expansion, the steady-state theory called for the appearance of no more than one hydrogen atom per cubic centimetre of space every 10^{15} years, a phenomenon well below the limits of conceivable observation. Those cosmologists eager to skirt the theological quagmire were more than willing to accept an exiguous amount of 'continuous creation' as the price to be exacted for once again thrusting the origin of the universe back to minus infinity, where they instinctively felt it belonged. This was unquestionably an important consideration for Hoyle, who in a 1950 radio broadcast stated:

> Some people have argued that continuous creation introduces a new assumption into science – and a very startling assumption at that. I do not agree that continuous creation is an additional assumption. It is certainly a new hypothesis, but it only replaces a hypothesis that lies concealed in the older theories, which assume ... that the whole of the matter in the universe was created in one big bang at a particular time in the remote past. On scientific grounds this big bang assumption is much the less palatable of the two. For it is an irrational process that cannot be described in scientific terms. Continuous creation, on the other hand, can be represented by mathematical equations whose consequences can be worked out and compared with observation. On philosophical grounds, too, I cannot see any good reason for preferring the big bang idea. Indeed, it seems to me in the philosophical sense to be a distinctly unsatisfactory notion, since it puts the basic assumption out of sight where it can be challenged by a direct appeal to observation.[3]

Steven Weinberg, a later champion of the Big Bang theory, put the matter bluntly: 'The steady state theory is philosophically the most attractive theory because it least resembles the account given in Genesis.'[4]

While the steady-state theory did not lack philosophical appeal, the observational evidence, sadly, soon began to tell against it. To begin with, continuous creation required particles and antiparticles to be produced at equal rates, which would lead to a symmetry between matter and antimatter. But the observed universe shows no such symmetry, rather a marked preponderance of one sort of matter over the other. Moreover, the discovery of quasi-stellar objects showed that the universe did, after all, change its appearance with time. The *coup de grâce* was delivered to the steady-state picture in 1965 with the discovery of the 'echo' of the Big Bang. In 1948 the physicists Ralph Alpher, George Gamow and Robert Herman had predicted that if the Big Bang scenario of a hot and dense past were correct, then some evidence of that past must remain in the form of residual radiation cooled by the universe's expansion to a temperature only a few degrees above absolute zero. In 1965 Arno Penzias and Robert Wilson happened upon this radiation field while calibrating a sophisticated radio receiver designed for satellite tracking. The radiation had a temperature of three degrees absolute – almost exactly as predicted – and subsequent observations revealed that its spectrum carries the distinctive Planck signature of heat radiation. The steady-state theory provided no plausible means of explaining the presence of a pervasive radiation field with just these characteristics. The Big Bang theory received further confirmation over its rival from the successful prediction of the cosmic abundances of helium, deuterium and lithium, all of which would be produced by nuclear reactions during the first three minutes of the expansion after the Bang. The steady-state theory could not explain this abundance of light elements.

By the mid-1960s the steady-state theory was, in the eyes of the majority of cosmologists, moribund. Nevertheless, despite the mounting observational evidence in favour of the Big Bang theory, Hoyle himself, along with a few of his followers, steadfastly refused to embrace it, undoubtedly because of a distaste for its postulation of a temporal origin of the universe. Hoyle's stubbornness in this regard was satirized in a verse by Barbara Gamow. Here Ryle is the British radio astronomer Martin Ryle, who, as a proponent of the Big Bang theory, engaged in extended debate, much of it acrimonious, with Hoyle throughout the 1950s and 1960s.

'Your years of toil,'
Said Ryle to Hoyle,
'Are wasted years, believe me.
The steady state
Is out of date.
Unless my eyes deceive me,
My telescope
Has dashed your hope;
Your tenets are refuted.
Let me be terse:
Our universe
Grows daily more diluted!'
Said Hoyle, 'You quote

Lemaitre, I note,
And Gamow. Well, forget them!
That errant gang
And their Big Bang –
Why aid them, and abet them?
You see, my friend, it has no end
And there was no beginning,
As Bondi, Gold,
And I will hold
Until our hair is thinning!'

Of course, such frivolity only served to underscore the eventual triumph of the Big Bang theory. A prominent cosmologist, Martin Rees, writing in 1999, had this to say on the matter:

> The empirical support for a Big Bang ten to fifteen billion years ago is as compelling as the evidence that geologists offer on our Earth's history ... A few years ago, I already had ninety per cent confidence that there was indeed a Big Bang – that everything in our observable universe started as a compressed fireball, far hotter than the centre of the Sun. The case now is far stronger: dramatic advances in observations and experiments have brought the broad cosmic picture into sharp focus during the 1990s, and I would now raise my degree of certainty to ninety-nine per cent.[5]

Mathematical support for the Big Bang scenario had been independently provided by the *Hawking–Penrose singularity theorems*. These demonstrate under certain seemingly plausible hypotheses within the general theory of relativity that the entire cosmos must have emerged from a universal singularity in the past, that is, had a 'beginning' in time. (These hypotheses are: (i) gravity is attractive and universal, (ii) the universe is now expanding and contains sufficient matter, (iii) there are no closed time-like lines, that is, time travel is impossible.) Before this universal singularity sprang into being, neither space, time, matter, nor the laws governing them can be said to have existed: in fact no meaning can be attached to the phrase 'before the singularity'. As in the Augustinian conception, the universe must be regarded as having materialized *ex nihilo.* But Hawking and Penrose did not follow Augustine in furnishing a reason as to *why* this singular event came to occur. All they asserted is that, under the specified hypotheses, the universe and the laws governing it cannot always have existed: they must have materialized at some moment in the past.

But the question of the universe's origin continued to nag. Reluctant to surrender this problem to the theologians and philosophers, some cosmologists attempted to remove the sting of the cosmological argument by treating the spontaneous emergence of the universe as a problem in physics. These physicists hoped that a suitable synthesis of quantum theory and relativity might enable the derivation of the initial singularity to be blocked. In that case, the putative 'beginning' or 'creation *ex nihilo*' of the universe need no longer be identified with something as elusive as a singularity, but could be instead invested with physical content. One such proposal was put forward in the early 1970s by Edward Tryon, who suggested that the universe may be nothing more than a gigantic 'vacuum fluctuation' in the sense of quantum

field theory. A typical example of a vacuum fluctuation is the occasional emergence of an electron, positron and photon from a perfect vacuum; when this happens, the three particles exist only for a brief time, and then annihilate each other, leaving no trace behind. Energy conservation is violated, but only for the brief particle lifetime Δt permitted by the uncertainty relation $\Delta E \Delta t \sim h$, where ΔE is the net energy of the particles and h is Planck's constant. The smaller ΔE is, the larger the lifetime Δt of the fluctuation can be. In particular, if ΔE is zero, then Δt can be any value whatsoever, however large. Now the laws of physics place no limit on the scale of vacuum fluctuations. So if the universe is closed and has zero net energy (for this to be possible the universe's total 'positive' mass energy must be balanced by its total 'negative' gravitational potential energy), it could be itself the result of a vast fluctuation of the vacuum of some hyperspace – the 'quantum void' – in which our own universe is embedded. By way of explanation for this remarkable occurrence, Tryon engagingly offered 'the modest proposal that our Universe is simply one of those things which happen from time to time.'[6] In Tryon's scenario, the emergence of our universe is a random occurrence, a sudden precipitation from the quantum void. This cannot be regarded as a creation *ex nihilo* since the void from which the universe sprang is assumed already to be present: like Newton's cosmos, the quantum void is sempiternal. Thus, once again, we have an 'escape into infinity'.

A far more radical proposal for avoiding the initial singularity was offered by Hartle and Hawking in the early 1980s. In this – the so-called 'no boundary' scenario – the universe's initial state is timeless, in that it possesses, not three spatial and one temporal dimension, but four spatial dimensions, the additional spatial dimension being called by Hawking 'imaginary time'. (The idea of introducing 'imaginary time' was first proposed by Minkowski in 1908 in order to allow the metric of special relativity to assume a Euclidean form.)

Thus the space–time geometry of the initial state takes a Euclidean form, which makes it possible for the universe to lack a 'beginning' but yet to be temporally closed. For just as the Earth's surface has no boundary at the North Pole, this initial region of the universe also lacks a boundary: it has no singular points. The geometry of the 'no-boundary' universe is similar to that of the surface of a sphere, except that it has four dimensions instead of two. In this analogy, unfolding in Hawking's 'imaginary time', Earth's North Pole represents the Big Bang, which, like the North Pole, is not a singularity. In that case, the universe itself cannot be said to have a 'beginning' in the usual sense of the word, at least not in respect of imaginary time. Hawking has made strong claims for the objective existence of the latter:

> Only if we could picture the universe in terms of imaginary time would there be no singularities ... When one goes back to the real time in which we live, however, there will still appear to be singularities. This might suggest that the so-called imaginary time is really the real time, and that what we call real time is just a figment of our imaginations. In real time, the universe has a beginning and an end at singularities that form a boundary to space–time and at which laws of science break down. But in imaginary time, there are no singularities or boundaries. So maybe what we call imaginary time is really more basic, and what we call real is just an idea that we invent to help us describe what we think the universe is like.[7]

And on one occasion Hawking asserted:

> I still believe the universe has a beginning in real time, at the big bang. But there's another kind of time, imaginary time, at right angles to real time, in which the universe has no beginning or end. This would mean that the way the universe began would be determined by the laws of physics. One wouldn't have to say that God chose to set the universe going in some arbitrary way that we couldn't understand. It says nothing about whether or not God exists – just that he is not arbitrary.[8]

In the 'no-boundary' scenario, the universe, viewed in imaginary time, is a kind of *ouroboros,* a (finite) snake eating its own tail. Because of this one might think that it avoids the singularity problem without making an 'escape into infinity'. But a closer look dispels this impression. For the 'no-boundary' scenario is founded on an esoteric application of quantum theory to classical geometrodynamics, involving the use of path integrals over ensembles of four-geometries to compute the wave function of the universe. And the ensemble E of four-geometries required by the 'no-boundary' theory must already be assumed to be present, in an ontological sense, at least, prior to the actual universe, like Tryon's 'quantum void', E was always 'there'. Is this not, implicitly, another 'escape into infinity'?

The 'escape into infinity' is also to be seen in the most recent, and speculative, scenario to be dreamed up by cosmologists – the so-called 'ekpyrotic' model. This term, which derives from the Greek word *ekpyrosis*, 'conflagration', is intended to evoke the ancient cosmological model associated with Heraclitus and the Stoics, according to which the universe is created (and recreated) in a sudden burst of fire. Here the hot Big Bang universe is conceived as arising from the collision of two three-dimensional worlds, or 'membranes', in a five-dimensional space. The all-embracing five–dimensional space is, again, taken to be infinite and as having in some sense always 'existed'.

Although it would seem that the majority of cosmologists wish to avoid drawing theological conclusions from the fact of the Big Bang, it should be pointed out that by no means all cosmologists are opposed to the notion that the universe was 'created'. John Polkinghorne, who resigned his professorship of physics at Cambridge to become an Anglican priest, is one example. Paul Davies's recent work gives evidence of an emerging deism. Some have argued that, given the Big Bang, the hypothesis that the universe was created has at least the merit of simplicity, and is therefore to be preferred to arcane conceptions such as Hawking's. This is the position espoused by the physicist N. Dallaporta, who has averred:

> In order to justify the various ... assumptions current in present day cosmology, it is necessary for each of them to build a frame of metaphysical postulates much more involved and artificial than the opposite straightforwardly metaphysical view of a universe built according to an a priori plan, requiring a planning Intelligence adequate to having conceived it.[9]

If the attempt to explicate what, if anything, happened 'before' the Big Bang has rekindled the cosmological argument, explaining what happened afterwards has ensnared cosmologists in a different, and perhaps better-known argument for the

existence of a Creator – the so-called 'argument from design'. This argument, which received its most celebrated elaboration in William Paley's *Natural Theology* of 1802, has been encapsulated by Bertrand Russell as follows: 'Everything in the world is made just so that we can manage to live in the world, and if the world was ever so little different, we could not manage to live in it.'[10] And indeed, recent work has demonstrated the exactness of the 'fine tuning' of the fundamental constants of nature necessary for ensuring that the universe has the requisite form making possible the formation of physical structures – galaxies, stars, planets – from which organic life, in particular ourselves, can eventually emerge. In his recent book, *Just Six Numbers,* Martin Rees identifies these constants. They are N, about 10^{36}, the ratio of the electrical to the gravitational force; E, about 0.007, which measures the efficiency of thermonuclear fusion of hydrogen to helium; Ω, the ratio of the actual density of matter in the universe to the 'critical' density at which the universe will eventually recollapse; Λ, the 'cosmological constant', the ratio of the putative force of cosmic repulsion to the force of gravity; Q, of the order of 10^{-5}, the ratio of the energy required for complete dispersal of a galaxy or galactic cluster to its rest mass energy; and finally D, exactly 3, the number of spatial dimensions of the universe. Had the values of these constants differed even slightly from their actual values, the structure of the universe would be altered to such a degree as to make the emergence of any form of organic life impossible. In Rees's words:

> if N had a few less zeros, only a short-lived miniature universe could exist: no creatures could grow larger than insects, and there would be no time for biological evolution.
>
> E ... controls the power from the Sun and, more sensitively, how stars transmute hydrogen into all the atoms of the periodic table. Carbon and oxygen are common, whereas gold and uranium are rare, because of what happens in the stars. If E were 0.006 or 0.008, we would not exist.
>
> Ω tells us the relative importance of gravity and expansion energy in the universe. If this ratio were too high relative to a particular 'critical' value, the universe would have collapsed long ago; had it been too low, no galaxies or stars would have formed.
>
> Fortunately for us ... Ω is very small. Otherwise its effect would have stopped galaxies and stars from forming, and cosmic evolution would have been stifled before it could even begin.
>
> If Q were [any] smaller, the universe would be inert and structureless; if Q were much larger it would be a violent place, in which no stars or solar systems could survive, dominated by vast black holes.
>
> Life couldn't exist if D were two or four.[11]

And even if human beings could exist under the last of these conditions, they would find frustrating the fact that they couldn't tie their shoelaces – there are no knots in even-dimensional spaces!

For the universe to have the structure it has, and in particular to have a structure compatible with the existence of life, these six numbers must apparently have been

'fine-tuned' to their actual values. As Rees points out, one could follow certain scientists in responding to this with a shrug of the shoulders and the remark that since we couldn't exist if these numbers failed to have these special values, and since we manifestly *do* exist, there's nothing to be surprised about. This is a version of the so-called *weak anthropic principle*, which Barrow and Tipler define as follows:

> The observed values of all physical and cosmological quantities are not equally probable but ... take on values restricted by the requirement that there exist sites where carbon-based life can evolve and by the requirement that the Universe be old enough for it already to have done so.[12]

Such a response seems less than satisfactory in that it fails to provide an *explanation* for the apparently remarkable fact that these six constants take just the values they do: the probability of their having done would seem to be infinitesimal. This has led John Polkinghorne to suggest, in a revival of the argument from design, that the 'fine-tuning' of these numbers furnishes evidence for the intervention of a beneficent Creator, who formed the universe with the specific intention of creating organic life, and, more especially, us.

Now the force of this contemporary version of the argument from design depends not just on the fact that the six constants have providential values, but also on the assumption that the universe in which they take these values is *unique*. By way of illustration let me offer the following quasi-Aesopian fable. The frogs in a certain pond, known to them as the *Universal Pond*, lead an idyllic life. Conditions in the Universal Pond are, the frogs note, perfectly adapted for batrachian existence – the water temperature is just right, neither too hot nor too cold; on the surface float a number of lily pads ideally designed, so think the frogs, for perching on; and there is an abundance of tasty insects providing an ideal source of nourishment. 'Now surely,' one can imagine a philosophically-minded frog arguing, 'the conditions in the Universal Pond cannot have arisen by chance. For the Universal Pond is, by definition, unique, and it is simply too unlikely that in this single case the temperature of the water, the dimensions of the lily pads, and the constitution of the insects would have the ideal values they in fact possess. These conditions must have been brought about by an intelligent Designer.' But what the frogs do not know is that in fact their Universal Pond is just one out of a vast ensemble of such, in which are manifested every conceivable variation of conditions. Many contain no frogs at all because the water is polluted or has dried up altogether. Others support a population of frogs leading a wretched flipper-to-mouth existence. The true explanation for the pleasant ambience afforded by the 'Universal' pond is quite prosaic, being no more than the chance fact that its inhabitants happen to reside in a pond in which such pleasant conditions obtain. The fable might conclude with a frog of unusual acuity grasping the possibility that other ponds might exist, and enunciating the 'weak batrachian principle', namely: *The observed values of all physical and limnological quantities are not equally probable but ... take on values restricted by the requirement that there exist sites where carbon-based, and, more especially, batrachian life can evolve and by the requirement that the Universal Pond be old enough for it already to have done so.*

Desirous of avoiding the conclusion that the universe was designed by a Creator, certain cosmologists have challenged the assumption of our own universe's uniqueness, suggesting that, instead, the universe we inhabit is just one among many. If physicists responded to the cosmological argument by 'escaping into infinity', some have met the argument from design with what might be termed an 'escape into plurality'. To quote Martin Rees again:

> If one doesn't accept the 'providence' argument, there is another perspective, which – though still conjectural – I find compellingly attractive. It is that our Big Bang may not have been the only one. Separate universes may have cooled down differently, ending up governed by different laws and defined by different numbers. This may not seem an 'economical' hypothesis – indeed, nothing might seem more extravagant than invoking multiple universes – but it is a natural deduction from some (albeit speculative) theories, and opens up a new vision of our universe as just one 'atom' selected from an infinite multiverse.[13]

> If indeed there were an ensemble of universes, described by different 'cosmic numbers', then we would find ourselves in one of the small and atypical subsets where the six numbers permitted cosmic evolution. The seemingly 'designed' features of our universe shouldn't surprise us, any more than we are surprised at our particular location within our universe.[14]

The 'multiverse' conception arises from the *inflationary universe* model devised by Alan Guth and others. This was originally introduced to explain the so-called 'horizon' and 'flatness' problems. The 'horizon' problem is the puzzle that widely separated regions of the universe are observed to share the same physical properties, such as temperature, even though these regions were too far apart when they emitted their radiation to have exchanged heat and so homogenized during the time since the Big Bang. The 'flatness' problem is the question of why the universe today is so close to the boundary between being open or closed, that is, why it is almost 'flat'. The essential feature of the inflationary universe model is that, shortly after the Big Bang, the infant universe underwent a brief (perhaps as little as 10^{-32} sec.) and extremely rapid expansion, after which it resumed the more leisurely rate of expansion of the standard Big Bang model. Andre Linde has taken this idea further in formulating what he called *chaotic inflationary universe* models. In such scenarios, an inflating universe fissions into a number of different fragments or 'bubbles', each of which is completely cut off from its fellows, so that the fragments are, in effect, independent universes. This fissioning process thus turns the inflationary universe into a 'multiverse'. The process may be repeated at random in the new 'universes', each of which accordingly spawns a whole flotilla of offspring – 'baby' universes – which, in their turn, reproduce in the manner of their progenitors. Individual universes would come and go, but in Linde's vision the whole ensemble of universes – the 'multiverse' – would last forever, and indeed, under the so-called 'eternal inflation' scenario, may always have existed. This is yet another 'escape into infinity'!

Towards the end of his book Rees remarks somewhat uncomfortably:

> If the underlying laws determine all the key numbers uniquely, so that no other universe is mathematically consistent with those laws, then we would have to accept that the 'tuning' was a brute fact, or providence.[15]

This prompts the following observation, with which I bring my cosmological musings to a close. Suppose that the laws of physics *did* indeed ultimately turn out to determine all the 'cosmic numbers' uniquely, so realizing the neo-Pythagorean view of the world propounded with great vigour by the celebrated English astrophysicist A.S. Eddington. Eddington, it will be recalled, championed to the point of obsession the idea that the dimensionless constants of nature have values which can be calculated a priori, perhaps most notoriously in the case of the 'cosmical number' – the total number of protons and electrons in the universe – which Eddington determined to be exactly 204.2^{256}. (The 'cosmical number' is a close relative of Rees's Ω.) He also believed that the 'fine structure constant' had the exact value of 1/137. This important dimensionless constant – the ratio to the velocity of light of the velocity of an orbiting electron nearest the nucleus of an atom in a ground state – was originally introduced by Sommerfeld: somewhat surprisingly, it failed to make the cosmologists' list of crucial numbers.[16] Eddington's intellectual adventures illustrate to perfection, it seems to me, the mental effects of cosmological speculation mentioned at the beginning of this essay.

Now if, as I have suggested, the laws of physics did turn out to determine all the 'cosmic numbers' uniquely – then the 'tuning' of the fundamental constants would be a *logical* consequence of the laws of physics. In that case, would not the acceptance of the 'tuning' as a brute fact, or providence, be tantamount to an acknowledgment that the *laws of physics* were *themselves* brute facts, or providence? Compare this with the analogous situation in mathematics. The value of π (say) is uniquely determined by the laws of mathematics, indeed, some would claim, by the laws of logic itself, but few are inclined to regard any such fact as 'brute' or providential, because mathematics, or logic, is taken to have an a priori character, a character customarily denied to physics. Most theists in fact accept that the deity is constrained to act in accordance with the laws of logic or mathematics – that is, if God eternally geometrizes, it's because he has no choice but to do so! Such laws are acknowledged by theists to be 'brute facts', only of a necessary nature over which God himself has no control. But if, by contrast, the laws of physics should turn out also to be unique or 'brute facts', that very contingency would make it natural for the theist to claim that they had been expressly selected from the spectrum of possibilities by divine choice. In order to block this new meta-version of the design argument without at the same time turning away from the goal of explaining the apparent uniqueness of the laws of physics, the agnostic might have to consider taking refuge in a sort of 'metaphysical pluralism', which countenances the actual existence of realms of being, inaccessible from ours, and governed by entirely different physical laws. Faced with this possibility, the agnostic can only hope against hope that the exact values of the 'key numbers' of our universe ever remain undeduced from the laws of physics.

Notes

1 Albert Einstein, *Relativity: The Special and General Theory*, trans. Robert W. Lawson (London: Methuen & Co Ltd, revised edition, 1924), Appendix IV: The Structure of Space according to The General Theory of Relativity (Supplementary to Section 32).
2 Quoted in J. Barrow, *The World Within the World* (Oxford: Clarendon Press, 1988), p. 227.
3 F. Hoyle, *The Nature of the Universe* (Harmondsworth: Penguin Books, 1963), p. 110.
4 Quoted in David Wilkinson, *God, Time and Stephen Hawking: An Exploration Into Origins* (Toronto, ON: Monarch Books, 2001), p. 56.
5 M. Rees, *Just Six Numbers* (New York: Basic Books, 2000), p. 10.
6 In J. Leslie (ed.), *Modern Cosmology and Philosophy* (Amherst, NY: Prometheus Books, 1998), p. 224.
7 S.W. Hawking, *A Brief History of Time: From the Big Bang to Black Holes* (New York: Bantam Books, 1988), p. 139.
8 Quoted in Howard J. Van Till, 'No Place for a Small God', in John Marks Templeton (ed.), *How Large Is God: The Voices of Scientists and Theologians* (Philadelphia; London: Templeton Foundation Press, 1997), p. 121.
9 In F. Bertola and U. Curi, *The Anthropic Principle* (Cambridge: Cambridge University Press, 1989), p. 163.
10 Bertrand Russell, *Why I am not a Christian, and other essays on religion and related subjects*, Paul Edwards (ed.) (London: G. Allen & Unwin, 1957), p. 6.
11 Rees, pp. 2–3.
12 John D. Barrow and Frank J. Tipler, *The Anthropic Cosmological Principle* (Oxford: Clarendon Press, 1987), p. 16.
13 Rees, p. 150.
14 Rees, pp 156–7.
15 Rees, p. 157.
16 Eddington's numerological obsession was, as many will recall, the subject of Bertrand Russell's amusing satire *The Mathematician's Nightmare* in his *Nightmares of Eminent Persons*.

Chapter 7

Whitehead, God, and Relativity

Richard Feist

The Problem

Process and Reality opens with Whitehead's oft-quoted declaration that speculative philosophy must struggle to '…frame a coherent, logical, necessary system of general ideas in terms of which every element of our experience can be interpreted'.[1] As science belongs among the elements of experience, it too falls under speculative philosophy's mandate.

Now Whitehead was no stranger to science; much of his speculative philosophy rests on its results – especially Einstein's relativity theory.[2] However, it does not follow that Whitehead's thought absorbed modern science completely, ensuring peaceful coexistence. There are conflicts to be sure.[3] But the relation between Whitehead's thought and modern science as a whole is too complex to be dealt with here. The same would apply to even the more limited issue regarding the relation between Whitehead's thought and Einstein's relativity. My concern in this essay is simply the problem of trying to construct a speculative philosophy that includes both God and the basic space–time framework of relativity.[4] As one philosopher has put it:

> If we assume that Einstein's relativity theory is giving us something close to the truth about space-time … then we must be sure that any form of process theology which we care to accept is tuned to harmonize with it.[5]

The attempt to harmonize process theology and relativity theory runs into a basic difficulty. The space–time framework of relativity abandons the idea of a privileged reference frame or perspective. Suppose that there exist two spatio-temporally distinct events, A and B. Call their temporal separation, T, their spatial separation, S. In relativity, there is no reference frame that can claim to give *the* values of T and S. This is not merely an epistemological impossibility concerning measurement of T and S; rather, it is an ontological error to presume that that there are such values answering to 'the correct value for T' and 'the correct value for S.'[6] In other words, different observers will give differing values for T and for S.

Whitehead's God, unlike the God of many traditional thinkers, has a temporal dimension. Whitehead calls this 'the consequent nature of God'. (Whitehead offers various reasons for God having this temporal dimension, but these are not of concern here.[7]) God experiences a changing world. He is, at least partially, in time and so possesses some kind of present in which he experiences the world. God, then, has a temporally bounded perspective. And it makes sense to ask, as the physicist John T. Wilcox once did, whether God's temporal perspective doesn't imply the existence of a preferred reference frame.[8]

In sum, the space–time framework excludes a preferred reference frame while the idea of a temporalized God demands it. So it would seem that Whitehead's process view of God and Einstein's space–time framework cannot enjoy a peaceful coexistence. The rest of this paper is a sketch of how Whitehead claims they can. But what is crucial – perhaps even central – to this combination of God and relativity is found in Whitehead's musings on Newton's *Scholium* on space and time.

Whitehead states that Plato's *Timaeus* and Newton's *Scholium* form the two guiding cosmological documents of Western thought.[9] However, they guide thought in two different ways. The virtue of the *Scholium* is that it is an accurate – albeit abstract – representation of the world, and thus any attempt to assemble an accurate, concrete representation of the world is an attempt to interpret the *Scholium*.[10] The vice of the *Scholium* stems precisely from its abstract nature: it passes over its possible interpretations in complete silence. Certain possibilities lead to error; and these, Whitehead claims, as a group fall victim to the 'fallacy of misplaced concreteness'. Yet one possibility – that suggested in Plato's *Timaeus* – looms before speculative philosophy as *the* interpretative beacon. More precisely, Whitehead reads the *Timaeus* as a poetic interpretation of the *Scholium*. (Unfortunately, Whitehead does not specify exactly which phrases and statements of the *Timaeus* reach 'their final lucid expression in the *Scholium*'.[11]) And Whitehead stresses the aspect of the *Timaeus* that is compatible but not entailed by the *Scholium*. This Whitehead deems the 'metaphysical character' of the *Timaeus* – the attempt to contain the behaviour of things within the formal nature of things.

The *Scholium* abstracts from the behaviour of things, concentrating solely on their formal nature. Whitehead writes:

> The *Scholium* betrays its abstractness by affording no hint of that aspect of self-production, of generation, of φύσις , of *natura naturans*, which is so prominent in nature. For the *Scholium*, nature is merely, and completely, *there*, externally designed and obedient. The full sweep of the modern doctrine of evolution would have confused the Newton of the *Scholium*, but it would have enlightened the Plato of the *Timaeus*.[12]

In sum, one must keep in mind Whitehead's declaration that the *Scholium*, when read within the limits of its abstraction, neither contains nor entails false statements.

Newton

Newton's *Scholium* begins with two main remarks on space and time. Regarding space, Newton writes:

> Absolute space, in its own nature, without relation to anything external, remains always similar and immovable. Relative space is some movable dimension or measure of the absolute spaces; which our senses determine by its position to bodies; and which is commonly taken for immovable space; such is the dimension of a subterraneous, an aerial, or celestial space, determined by its position in respect of the earth. Absolute and relative space are the same in figure and magnitude; but they do not remain always numerically the same.[13]

Absolute space is simply a fixed collection of points which never change in position. They *are* the positions and are indifferent to whether or not they are occupied by objects. However, absolute space points are not independent of *everything*. For instance, they are not independent of God. Indeed, Newton holds that God is the ultimate basis of absolute space, calling absolute space God's 'boundless uniform sensorium'.[14]

Regarding time, Newton writes:

> Absolute, true, and mathematical time, of itself, and from its own nature, flows equably without relation to anything external, and by another name is called duration: relative, apparent, and common time, is some sensible and external (whether accurate or unequable) measure of duration by the means of motion, which is commonly used instead of true time; such as an hour, a day, a month, a year. [15]

This passage is often quoted, but rarely is it examined closely.

First, Newton distinguishes between physical and absolute time. Measuring instruments, such as clocks, provide the former as they attempt to measure durations of absolute time. The analysis of Newton's concept of absolute time discloses its three distinct elements: a structure; a collection of 'indivisible moments'; a flow. In sum, Newton offers an ontology of absolute time, not merely a structural description of it, as some contemporary commentators claim.[16]

The structure of absolute time is an ordering. Each 'place' in this order is fixed and unique; and each place has a unique preceding and succeeding place. Call this order R. The reason for R's existence lies within the essence of God, who is the origin of all possible orders. This deistic explanation of the origin of order, and Newton's view of this origin and absolute time, illustrate Newton's adherence to the Cambridge neo-Platonic tradition.[17]

The collection of indivisible moments of absolute time is not a mere aggregate; rather, it is ordered by R. Because these moments are distinct, they are external to each other. Consequently, moments cannot be within God, for Newton holds that God is a unity.[18] R prevents moments from any change of 'place' with respect to each other; they are immovable.[19] Each moment can be regarded as characterized by two predicates. First, it has a place in an 'immutable order'. Moments are lined along an 'axis of time', ordered by 'succession' or 'earlier/later', and there is a fixed metric or 'distance along' this axis. If an event, A (lightning flash), occurs and then an event, B (car horn), occurs, there exists an ordered set of moments, D, bounded by the moment 'containing' A and the moment 'containing' B.[20] D is absolute; all possible observers – were they possessed of perfect clocks – would arrive at the same measurement for D. Further, were all matter to vanish after event A and return at event B, D would still exist.[21] Second, each indivisible moment is 'everywhere'. If any spatial point is assigned a particular moment, Q, then every spatial point is assigned that moment, Q. Time assignments, then, are global in Newton's system. Clearly there is no sense of flow to a structured set of indivisible moments. These two elements of absolute time, then, are static.

Does Newton mean anything by 'time flowing' or not? Again, many modern interpreters – without argument – ignore Newton's comments on time's flow. But to

ignore Newton's comments on time's flow is – to borrow a term from Bergson – to 'spatialize time'. This makes time into an extension that is not unlike that of space. Newton specifically states that time flows and I take him at his word.[22]

Newton states that absolute time 'flows equably without respect to anything external'. This notion of 'time flowing' must be unpacked. To do so requires some reflections on the logic of the term 'flow'.

'X is flowing' is normally regarded as elliptical for 'X is flowing with respect to Y'. For X to flow with respect to Y, X and Y must be distinct and their distinctness must in some sense vary. When we interpret 'X is flowing with respect to Y', we often use physical examples, such as 'the river is flowing with respect to its banks'. Physical examples interpret 'distinctness' and 'varying distinctness' as 'spatially external' and 'changing spatial relations' respectively. But physical interpretations of 'distinctness' and 'varying distinctness' are not logically demanded. As mentioned, moments are distinct, but they are not so in a physical (that is, spatial) sense.

There is a descending clarity in Newton's analysis of absolute time. The structural description is clear. The description of moments is less so. And the notion of 'flow' is not discussed at all – merely stated. But this does not entail that it is an unimportant part of Newton's concept of absolute time. I suggest that it was so obvious and primitive to Newton that he did not feel it necessary to articulate it.

So far this has only considered the external, structural features of moments. Again, what would be flowing here? Newton never specifically says in his writings. It seems that the only characteristic that a moment could possess contingently would have to be something that is not an external, structural feature of it. Each moment must have the capacity to bear a property and lose it. That is, a moment could possess the unique, characteristic property 'now' and then lose it. All this happens without any kind of alteration of a moment's external relations to other moments. This 'now' flows along the temporal axis, characterizing moments.

But there are two characteristics of this flow; it is equable and unidirectional. In other words, the movement of the 'now' is ordered. This order, like that of R, would have its foundations in God.

Not until many years after writing the *Scholium* on space and time did Newton try to provide some kind of explanation regarding God and the foundations of space and time. I say 'some kind of explanation' since what he offers is rather sparse. But, considering what has been said about the abstractness of the *Scholium*, this is hardly surprising. Newton states that a person – presumably a soul – is both 'extended' over time and space and yet does not itself contain externally related parts.[23] The soul experiences the world via a temporally bound perspective, although for its duration in the world, the soul does not contain temporal moments. The soul, then, is a true unity. Immediately, Newton draws an analogy: as a soul is unified over a finite extension of space and finite duration of time, God is unified over an infinite extension of space and infinite duration of time. Moreover, Newton holds that God, although he perceives the world, 'suffers nothing from the motion of bodies' and in turn, bodies 'find no resistance from the omnipresence of God'.[24] Newton, typically, passes over the possible interpretations of these comments in silence. But the point here is that God, although he is related (somehow) to the world, is not bound by physical laws. The third law of motion, clearly, does not apply to God.

Whitehead

Whitehead stresses repeatedly in *Process and Reality* that actual entities do not move. In this sense, actual entities play a very similar role in Whitehead's thought as the points of space and time play in Newton's. Whitehead writes:

> When we further consider how to adjust Newton's other descriptions to the organic theory [Whitehead's speculative philosophy], the surprising fact emerges that we must identify the atomized quantum of extension correlative to an actual entity, with Newton's absolute place and absolute duration. Newton's proof that motion does not apply to absolute space, which in its nature is immovable, also holds. Thus an actual entity never moves: it is where it is and what it is.[25]

As we have seen, what differentiates Newton's absolute space and time points from Whitehead's actual entities is that Newton's absolute space and time points are there: ready-made, supremely indifferent to very the fact of occupation, let alone the content of a possible occupant. This property of 'ready-madeness' permeates Newton's thought.

Yet there is an element of Whitehead's thought that does, despite Whitehead's somewhat slippery terminology, play the role of a Newtonian ready-made spatio-temporal structure. This is Whitehead's extensive continuum, a generalization and mathematization of Plato's Receptacle. It is a generalization since it would not possesses properties that the receptacle would, such as 'dimensionality'. This generalization of the Receptacle was done via Whitehead's knowledge of higher mathematics. The extensive continuum can only be adequately characterized in the language of mathematics. But the extensive continuum is very much like the Receptacle – and Newton's absolute space and time – in that it is ontologically prior to anything that may be within it. Further, these three structures are all a-temporal in that they neither come to be nor cease to be. Indeed, Whitehead states that the extensive continuum is not a fiction, it is *real*. Moreover, its reality stretches from past eternity to future eternity.[26] However, when it becomes actualized by the actual entities, the extensive continuum acquires definiteness and becomes part of the actual world: the world experienced by actual entities. This is unlike Newton's view and like Plato's Receptacle, upon which forms are impressed.

The main point here is that even the space–time structure of relativity, which Whitehead accepts, is a particular form imposed on the extensive continuum; this particular form is one possible space–time structure that could have been imposed. As Whitehead stresses, space–time is but one ordering and there is no such thing as an absolute order.[27]

Much of what Whitehead describes in terms of the actualization of the basic atoms of his metaphysics, the actual occasions or actual entities, can be squared with this notion of an eternal extensive continuum. The eternal extensive continuum could be thought of as some kind of topological manifold. In itself it possesses a very weak structure: no spatial or temporal lengths, indeed, no geometrical structure at all.[28] Rather, it is a manifold that could be particularized in various ways, from various perspectives or standpoints of actual entities as well as a particular geometric particularization. Again, our epoch is but a particular set of compossible perspectives

and a particular geometric form. We could say that actual entities realize a region of extension, not the extension of a region. Whitehead writes that: 'The extensiveness of space is really the spatialization of extension; and the extensiveness of time is really the temporalization of extension.'[29] Further, this reading allows for the idea of geometric development – one that Whitehead insists upon – that although the current cosmic epoch has a four-dimensional semi-Riemannian structure, this may not be the case in the distant future. In other words, a future cosmic epoch may have not only a different geometric structure, but also perhaps not even the same number of dimensions as ours.

But, as I mentioned, this runs into difficulties with some of Whitehead's other metaphysical principles. These principles, Whitehead insists, are not mutually exclusive or independent. Consequently, modifying one principle will inevitably lead to the modification of others. Regarding the extensive continuum itself as eternal clashes with Whitehead's reformed subjectivist principle. He stresses that there is no 'outside' to actual entities, no 'outside' to the experiences of actual entities. In Whitehead's words, 'Apart from the experiences of subjects there is nothing, nothing, nothing, bare nothingness.'[30] This has led some commentators to interpret Whitehead as holding that the extensive continuum *itself* grows, bit by bit. So the extensive continuum should not be thought of as eternal. This reading, however, clashes with Whitehead's comments that the extensive continuum per se, or what I have called the eternal extensive continuum, underlies all cosmic epochs. What I want to read into this is that it is the particularized extensive continuum (for instance, our space–time cosmic epoch) that grows in this fashion, not the eternal extensive continuum.

The future, Whitehead tells us, is merely real, not actual.[31] The eternal extensive continuum that extends into the future lacks determinacy; it is not some thing that is 'there', since to say that 'the extensive continuum is there' is to qualify it or determine it in some fashion. Again, the extensive continuum, in itself, lacks determination. So, I read Whitehead's reformed subjectivist principle as saying that we are not to think that the eternal extensive continuum is some kind of container (possessing a determinate form) and is 'waiting' to be *filled*; rather, it is 'waiting' to be *formed*.

Whitehead stresses the distinction between metaphysical propositions and propositions true of a cosmic epoch. His discussion of the mechanics of concrescence (internal developments of actual entities) presupposes, he says, relativistic mechanics. That is, presentational immediacy, one of Whitehead's modes of perception, has the metaphysical presupposition of what we would now call the conical structure of Minkowski space–time. But this cannot be a 'metaphysical presupposition', for then it would be an absolute space–time order, as ready-made as anything Newton ever proposed.

Regular actual entities are, in our cosmic epoch, participants in this Minkowskian space–time order. Consequently, it comes as no surprise that the concrescence of actual entities is tightly connected to this space–time structure. However, since Whitehead admits that future cosmic epochs may not possess this particular space–time structure, it would seem to follow that perception itself could be different. In other words, Whitehead's analysis of the modes of perception is not something

fixed; it, too, is processual. Hence, the very structure of perception could indeed vary from cosmic epoch to cosmic epoch.

If the previous, admittedly somewhat sketchy, discussion is viable, then the structure of concrescence itself is not a particular species but a genus. These various species of concrescence are 'together' in a genus, namely, a possible ordering within the primordial nature of God. The notion of different types of concrescence can find support in that Whitehead insists that certain epistemological laws that govern the concrescence of 'regular actual entities' (actual occasions) simply do not apply to God. Whitehead writes that 'God differs from other actual entities in the fact that Hume's principle, of the derivate character of conceptual feelings, does not hold for him.'[32] So we have here, at least, two different orders of concrescence. Regular actual entities commence by their physical feelings of the world whereas God 'commences' with his conceptual feelings. Even though Whitehead states that God is not an exception to all metaphysical principles,[33] he is at least exempted from some of them.

Another exemption for God is that he is unique in that he does not actualize a region of the extensive continuum. If he did, he would have to have some actual world upon which he could perform the synthesis and then actualize the region. For if he did, then he would be bounded, having a past and a future like a regular actual occasion. God, Whitehead stresses, has no past.[34] God is neither before nor after the world. God is: '… an actual entity immanent in the actual world, but transcending any finite cosmic epoch – a being at once actual, eternal, immanent, and transcendent.'[35] Although Whitehead goes on to declare that the transcendence of God is not unique to him, since actual entities also transcend their actual worlds, the notion of 'transcendence' here cannot be univocal. For actual entities do not 'transcend their cosmic epochs'.[36]

Once again if God transcends cosmic epochs, he would not be bound by the orders that dominate them. It would be the other way around: God would be the ground of those orders.

The Preferred Reference Frame

Now I would like to return to the original problem, namely that of a preferred reference frame. All actual entities, given that they actualize a portion of the extensive continuum and that this actualization is governed by the space–time framework of relativity, clearly could never enjoy a preferred reference frame. Even though God is another actual entity, he is not bound by the prohibition of an absolute reference frame, any more than Newton's God would be bound by the third law of motion.

Nonetheless, there is a price to be paid for this, namely, that Whitehead's attempt to put relativity theory and God together – his attempt to employ the *Timaeus* in an interpretation of the *Scholium* – winds up not much further than Newton, if it goes that far at all. That is, God's prehensions of the world, his physical prehensions, cannot be identical to the type of physical prehensions that regular actual entities have. If so, God violates relativity. But, if not, then what exactly is a divine physical prehension? Again, like Newton, Whitehead might have to admit that whether we

speak of our perceptions and God's perception, or our physical prehensions and God's physical prehensions, speaking analogously is simply the best we can do, albeit philosophically unsatisfying.

In sum, I suggest, and this is not a unique view, that we should read two types of time into the metaphysics of Whitehead. One type, namely that belonging to physics, is the time that is actualized by actual entities. Within this perspective, there is no preferred reference frame. Let us call this 'physical time'. All the investigations of science would be within this physical time. The other sense of time I will term 'metaphysical'. This would be the time that is, so to speak, connected to the eternal extensive continuum. This would be the temporal perspective of God. God, then, would not be 'in' time in the same fashion as actual entities are. He would be there to provide the initial subjective aim for actual entities, that is, the initial guiding *telos* or direction that becomes determined via the growth of actual entities. He would also be there to perceive the final growth of actual entities – that is, to register their satisfaction upon their completion and thus augment His own Consequent Nature.

Notes

1 Alfred North Whitehead, *Process and Reality, An Essay in Cosmology,* corrected edition, D.R. Sherburn and D.W. Griffin (eds) (The Free Press: New York, 1978), p. 3.

2 Not only science's latest but mathematics' as well were crucial for Whitehead's development – especially the developments in the foundations of analysis and projective geometry. Mathematical technicalities dominate part IV of *Process and Reality*, 'The Theory of Extension'. But these influences are not relevant to my concerns here.

3 One such conflict concerned the very foundations of relativity, namely the articulation of 'simultaneity'. Whitehead and Einstein did not see eye to eye on this, although their disagreement is a topic for another time.

4 This paper only deals with the framework of special relativity, not general. Whitehead rejected the general theory.

5 Paul Fitzgerald, 'Relativity Physics and the God of Process Philosophy', *Process Studies*, 2/4 (1972): 251–76.

6 Of course the theory holds that T and S are related by the 'invariance of the interval', a value that all observers would agree upon, based on their calculations involving their observed T and S. Nonetheless, what observers in fact *observe* as opposed to *calculate* would in fact differ.

7 Whitehead insists that God has a temporal dimension because God must exemplify the principles of the metaphysical system. One of the principles is that actual entities all prehend (or feel) the world. None of them is in absolute isolation. God is another – albeit special – actual entity. Actual entities are the basic atoms of Whitehead's metaphysics, which is essentially a monadology. For more details of Whitehead's God, see *Process and Reality*, part V.

8 J.T. Wilcox, 'A Question from Physics to Certain Theists', *Journal of Religion*, 40/4 (1961): 293–300. Several years earlier, Charles Hartshorne raised a

similar concern regarding relativity's rejection of absolute reference frames and the perspective of God on the world (see his 'Whitehead's Idea of God', in P.A. Schlipp (ed.), *The Philosophy of Alfred North Whitehead* (New York: Tudor Publishing Company, 1951), p. 545).

9 Whitehead, *Process and Reality*, p. 93.

10 Whitehead, *Process and Reality*, p. 94.

11 Whitehead, *Process and Reality*, p. 94.

12 Whitehead, *Process and Reality*, p. 93.

13 Newton, *Scholium on Absolute Space and Time*, quoted from *The Scientific Background to Modern Philosophy, Selected Readings*, M.R. Matthews (ed.) (Indianapolis: Hackett Publishing, 1989), p. 139.

14 Newton, *Optiks*, quoted from *The Scientific Background to Modern Philosophy,* p. 157. This notion of God 'feeling' the world becomes the consequent nature of God for Whitehead.

15 Newton, *Scholium,* p. 139.

16 John Earman is such a commentator. For Earman's discussion of Newton see his *World Enough and Space-Time* (Cambridge, MA: The MIT Press, 1989), pp. 7–11. Earman mentions – but subsequently ignores – Newton's theological foundations for absolute space. Earman entirely ignores Newton's theological foundations for absolute time.

17 I thank Professor Leslie Armour for pointing this out to me in private conversation.

18 I will return to the idea of the unity of God presently.

19 Newton, *Principia*, quoted from *The Scientific Background to Modern Philosophy, Selected Readings*, p. 141.

20 There is a bit of leeway in the language here since by definition moments are indivisible and so cannot contain events, which by definition are temporally extended. More precisely put, moment A is the final moment in the lighting flash event and moment B is the initial moment of the car horn event.

21 Newton clearly is breaking here with a tradition in philosophy of time that runs from the ancients and throughout the period known as 'modern philosophy', namely, that time is the measure of motion.

22 One reason for ignoring Newton's comments on time's flow appears to stem from the contemporary desire to formulate Newton's absolute space and time theory from a modern space–time perspective. This is an admittedly complex issue, but I would say that this desire is but another attempt to understand historical figures using contemporary concepts, which often leads to distortions.

23 Newton, *Principia*, quoted from *The Scientific Background to Modern Philosophy, Selected Readings*, p. 150.

24 Newton, *Principia*, quoted from *The Scientific Background to Modern Philosophy, Selected Readings*, p. 151.

25 Whitehead, *Process and Reality*, p. 73.

26 Whitehead, *Process and Reality,* p. 66.

27 Whitehead, *Process and Reality,* part II, ch. 3, 'The Order of Nature'.

28 Whitehead, *Process and Reality,* p. 66.

29 Whitehead, *Process and Reality,* p. 289.
30 Whitehead, *Process and Reality,* p. 167.
31 Whitehead, *Process and Reality,* p. 214.
32 Whitehead, *Process and Reality*, p. 87.
33 Whitehead, *Process and Reality*, p. 343.
34 Whitehead, *Process and Reality,* p. 87.
35 Whitehead, *Process and Reality*, p. 93.
36 This is not to deny their objective immortality, but that is only after their concrescence has completed.

Chapter 8

Design Inferences, Fine-Tuning, and the Prior Probability of Divine Intelligent Agency: What the Fine-Tuning Argument Shows[1]

Kenneth Einar Himma

Proponents of fine-tuning arguments attempt to infer the existence of God from the presumably improbable fact that the universe is able to support life. Life would not be possible if any of approximately two dozen fundamental laws and properties of the universe had been even slightly different; this, according to the argument, shows the existence of a creator who deliberately created the universe for the purpose of supporting life.

In this essay, I consider the Confirmatory Version of the argument, which relies on the following application of confirmation theory: if the appearance of fine-tuned properties is more likely to occur if theism is true than if theism is false, then the appearance of fine-turned properties provides epistemic grounds for preferring theism to atheism. In this essay, I argue that the Confirmatory Version provides very weak grounds for preferring theism to atheism. Further, I argue that its epistemic force cannot be buttressed with an appeal to other design arguments.

The Confirmatory Version of the Fine-Tuning Argument

In the last forty to fifty years, scientists have identified approximately two dozen properties and laws of the universe that had to be just right for there to be life. Life would not be possible, for example, if the explosive force of the big bang had differed in strength by as little as one part in 10^{60}, because the universe would have either collapsed or expanded too rapidly for stars to form. Similarly, life would not be possible if the force binding protons and neutrons together had differed by as little as five per cent. Nor would life be possible if the force of gravity had differed by as little as one part in 10^{40}; nor if the ratio of the mass of the neutron to the mass of the proton had been different. As the matter is commonly put, the universe appears to have been 'fine-tuned' for life.

While the claim that it is a matter of chance that so many things could be exactly what they need to be for life to exist in the universe seems too improbable to be true, the issue, however, is how to formulate this intuition in a philosophically and mathematically rigorous way. One way is to compare the probability of life under the hypothesis (the Theistic Hypothesis) that there exists a perfect God who created

the universe such as to support life to the probability of life under the hypothesis (the Atheistic Single-Universe Hypothesis) that there exists only one universe, and it is just a matter of chance that this universe has properties that appear to be fine-tuned. On this line of analysis, which I will call the Confirmatory Version, the probabilities of two hypotheses are assessed according to the following principle:

> **Principle of Confirmation (PC)**: If an observation O is more likely under hypothesis H1 than under hypotheses H2, …, Hn, then, other things being equal, we have epistemic grounds to accept H1 over H2, …, Hn.

The relevant probability comparisons under PC are straightforward. To begin with, the existence of life is not improbable under the Theistic Hypothesis; since, as most people believe, a universe with free intelligent living beings, other things being equal, is morally preferable to a universe without such beings, it seems to follow that the probability of a fine-tuned universe under the Theistic Hypothesis is close to 1. Moreover, given that there are a large number of logically possible values for the various fundamental constants and parameters, one would not expect intelligent conscious beings to exist under the Atheistic Single-Universe Hypothesis. Thus, the epistemic probability of a fine-tuned universe under the Atheistic Single-Universe Hypothesis appears to be low – though we can't say exactly how low it is.

The Confirmatory Version, then, proceeds as follows. If the Theistic Hypothesis is true, the appearance of fine-tuning is very likely since a perfect God would presumably want life in the world. In contrast, if the Atheistic Single-Universe Hypothesis is true, then the appearance of fine-tuning is not very likely. Since the appearance of fine-tuning is hence more probable under the Theistic Hypothesis than under the Atheistic Single-Universe Hypothesis, it follows, other things being equal, that we have epistemic grounds to prefer the Theistic Hypothesis over the Atheistic Single-Universe Hypothesis.

As I have formulated the argument, however, it is ambiguous because there are a number of different ways to interpret the important notion of 'epistemic grounds'. For example, one could interpret the notion as asserting that we are *epistemically warranted* in accepting the existence of God as an explanation of fine-tuning. Alternatively, one could interpret the notion as merely asserting we have strong epistemic grounds to accept the Theistic Hypothesis. On this interpretation, the Confirmatory Version simply provides an epistemically weighty reason, which may be outweighed by other reasons, to accept the Theistic Hypothesis.

Either way, the argument is problematic. To see why, it will be helpful to consider another application of PC. Let O be the observation that John Doe wins a 7,000,000-to-1 lottery. Let H1 be the hypothesis that an omnipotent, omniscient God wanted John Doe to win the lottery and intervened for the purpose of ensuring that John's numbers were drawn. Let H2 be the hypothesis that the lottery numbers are randomly selected. Notice that under H1, the probability that John wins the lottery is 1; for it is not possible for an omnipotent, omniscient God who intervenes to ensure John's numbers are drawn to make a mistake in those circumstances. Notice further that under H2, the probability that John wins the lottery is very small; for, as I described the example, the odds are 1 in 7,000,000. Thus, O is considerably more probable

under H1 than it is under H2. Accordingly, it follows from PC that we have epistemic grounds for preferring H1 over H2; otherwise put, it follows that we have epistemic grounds to prefer the hypothesis that an omnipotent, omniscient God has intervened for the purpose of ensuring that John's numbers are drawn.

The obvious problem with this application of PC is that it commits us to claiming that the most likely explanation for *any* instance in which some person *P* wins a lottery is that God intervened to ensure that *P*'s numbers come up. There is, of course, no reason to think that an omnipotent God couldn't do this. Indeed, one might even go so far as to suppose that a morally perfect God would do so on rare occasions. Nevertheless, it is certainly not the case, according to standard theological views, that God routinely intervenes in lottery drawings to ensure that a particular person wins on any given occasion. On either interpretation of the locution 'epistemic grounds', the lottery example is a counter-example to the fine-tuning argument.

What ultimately goes wrong with this version of the fine-tuning argument is that PC can't be used to avoid having to assess the prior epistemic probabilities of the hypotheses in question. The reason that PC yields the incorrect answers in the lottery examples, regardless of which of the two strong interpretations of 'epistemic grounds' we choose, is that the prior probability of the chance hypothesis is considerably higher than the prior probability of the hypothesis that God intervenes to select winning lottery numbers. On the one hand, we know that lottery games are deliberately set up to incorporate mechanisms that randomly generate winning sequences of numbers; thus, our confidence level in the chance hypothesis (that is, its prior epistemic probability) is high. On the other, standard theological considerations indicate that a perfect God wouldn't intervene in the world in a piecemeal way except in extraordinary circumstances that don't include weekly lottery games; thus, the prior probability of the hypothesis that God selects the winning number is extremely low. In circumstances where one hypothesis has a considerably higher prior probability than another, PC simply doesn't apply – though it is difficult to say how much higher one prior probability must be than another to render PC inapplicable.

Thus, application of PC presupposes that we have strong independent evidence for thinking that the right kind of intelligent agencies exist. Application of PC to the lottery example is problematic precisely because we lack sufficient reason for thinking (1) that God exists and (2) that God would act in such a way as to bring it about that particular people win lotteries as they occur. And, again, this is true regardless of whether we interpret 'epistemic grounds' as epistemically warranting acceptance of a hypothesis or as merely providing strong evidence for that hypothesis. But inasmuch as application of PC presupposes the existence of the right kind of intelligent agency, the Confirmatory Version of the fine-tuning argument begs the question.[2]

The Application Conditions of Design Inferences

One might attempt to view the Confirmatory Version of the fine-tuning argument as one plank in a more complicated line of analysis that ultimately relies on the force of

a number of different empirical arguments taken together. As Collins points out with respect to the Confirmatory Version:

> [T]he argument does not say that the fine-tuning evidence proves that the universe was designed, or even that it is likely that the universe was designed. In order to justify these sorts of claims, we would have to look at the full range of evidence both for and against the design hypothesis, something we are not doing in this chapter.[3]

On this line of analysis, then, the design argument can be seen as comprising a number of different design inferences. Thus, for example, the design argument would include evidence of fine-tuning, but it would also include evidence of what Michael Behe calls irreducible specified complexity.[4] Taken together, on this construction, these arguments are sufficient to justify the conclusion that the Theistic Hypothesis is empirically justified.

At first glance, this seems to address the primary problem with the Confirmatory Version of the fine-tuning argument. As we have seen, the lottery examples show that the Confirmatory Version can't be used to circumvent having to calculate the prior probabilities of the relevant hypotheses. What I will call the Cumulative Design Strategy seems to resolve this problem by using the other design arguments to provide a fuller picture of the comparative probabilities of the two hypotheses. Thus, since it is reasonable to think that the various design arguments, taken together, are sufficient to provide the necessary probabilistic background, the Cumulative Design Strategy is sufficient to establish that God's existence is empirically more likely than God's non-existence and hence that we are empirically justified in accepting the Theistic Hypothesis.

It is not entirely clear that the Cumulative Design Strategy can provide the necessary probabilistic support. An example will help to shed light on the concern. Suppose that you are a space traveller and that, during your travels, you pass close enough to, say, a planet to notice a surprising arrangement of rocks. They are intricately arranged into the shape of the following phrase: 'Ken was here.' The immediate temptation is to make a design inference. In particular, you will undoubtedly consider drawing the conclusion that some personal, intelligent agent had visited this planet and deliberately arranged the rocks to form these words; in fact, you might very well be tempted to think the agent's name was Ken.

But notice that how much epistemic force the inference has will depend on your proximity in space to a portion of the universe where you have good grounds for supposing that intelligent life exists. If, for example, you are very close to Earth, then the force of the design inference will be fairly strong – though you will undoubtedly have many questions about who could have done this. Similarly, if the location of the stones is fairly near another planet where it is clear that there are sufficient resources to support intelligent life, then the force of the inference will also be strong. Even so, it is worth noting that the epistemic force of the design inference will not be quite as strong as it would be were you close to the Earth; after all, knowing that there is a nearby planet that *can* support life is not the same as knowing that there is a nearby planet that *does* support life.

The force of the inference, however, diminishes even more the further you are from planets you know are capable of supporting life. There are two situations to be distinguished here: (1) you are a substantial distance from the last place you know to be capable of supporting life and you know that there is nothing within that distance (in any direction) that is capable of supporting life; and (2) you are a substantial distance from the last place you know to be capable of supporting life but you *do not know* whether there is anything else within that distance (in any direction) that is capable of supporting life. It should be clear that whatever epistemic (or probative or evidentiary) force that the design inference has in either of these contexts, its force in (2) exceeds that in (1). As an epistemic matter, you are justified in having more confidence in the design inference if you are in situation (2) than you would be in situation (1) – though it is clear that the force of the inference in both situations is considerably weaker than it would be if you knew yourself to be near a planet that is capable of supporting life.

What this discussion, then, suggests is this: the epistemic force of the design inference in these situations depends, at least to some extent, on the prior probabilities of the Design Hypothesis that some intelligent agent is responsible for having arranged the rocks in the form of the message 'Ken was here'. Information about the proximity of planets capable of supporting life figures into a determination of the prior probabilities of the Design Hypothesis. For example, the prior probability of the Design Hypothesis is higher if you know that you are near a planet that *does* support life than if you know only that you are near a planet that *can* support life. And the prior probability of the Design Hypothesis is higher if you know that you are near a planet that can support life than if you have no idea whether you are near a planet that can support life. And so on.

This should not be taken to deny that the Design Hypothesis gets independent support from the relevant observation of apparent design. And this is as it should be: design inferences are supposed to provide support that is independent of and in addition to the prior probabilities. To deny that the claim that the Design Hypothesis gets some support from the new observation would entail the implausibly sceptical claim that design inferences are incapable of contributing evidentiary value (or epistemic force) to design hypotheses – a *reductio*, I think, of any claim that entails it.

Nor should this be taken to deny that how much independent support the Design Hypothesis gets will depend on the level of observed specified complexity. Clearly, the design inference will have greater epistemic force if the observation involves rocks arranged in the form of a complete Shakespearean sonnet than if the observation involves rocks arranged in the form of the phrase 'Ken was here'. Part of what makes design strategies epistemically relevant is that, so to speak, the occurrence of random specified complexity in any universe is presumptively improbable – and the higher the level of observed complexity the higher the improbability of the presumption that it can't be explained in terms that don't make reference to intelligent agency.

Even so, the fact that the epistemic force of design inferences is limited by the prior probabilities of the relevant design hypothesis tells us something very important about design inferences in general. Notice that, no matter where we are in *this* universe, the design inference from the observation of the rocks in the form of 'Ken was here' will have *some* epistemic force – though this force will vary according to

our physical proximity to locations that are known to be able to support physical life. In this universe, the prior probability of *any* hypothesis positing the existence of an intelligent material being is non-zero, other things being equal, because we *know* that this universe contains such life. Thus, in this universe and hence against the epistemic backdrop of these known prior probabilities, any design inference from observed complexity will have some determinate, if not fully determinable, epistemic force.

But the epistemic situation is radically different if we have no information about the prior probabilities of the relevant design hypothesis. Suppose, for example, that we are transported to a different logically possible universe where we observe the rock formation. Suppose, further, that we know (1) that we are in a different world and (2) that this observation is all we have to go on in determining whether there is intelligent life in that universe. In this world, it is simply not clear how much epistemic support, if any, the observation could provide for a design hypothesis. In our world, it is clear that the further you get from a location where you know there either is or could be intelligent life, the less epistemic force the design inference has. But this suggests that we can't confidently assign much in the way of epistemic force to any design inference in a world where we have no other information whatsoever about the probability of intelligent life.[5]

The problem with respect to theistic design arguments is that we are in exactly the same epistemic position with respect to God's existence in *this* world that we would be in with respect to the existence of intelligent life in another logically possible world. If we concede for the sake of argument that the other arguments for and against the existence of God have indeterminate epistemic force, then we have no reliable information about the prior probabilities of the existence of a being that instantiates all the perfections and that exists, at least in part, outside of time and space. The existence of intelligent agents like us in this universe, by itself, doesn't tell us anything about the probability that there exists a being that has properties that are so different from those instantiated by human beings. That, in part, is why theists and atheists repair to other strategies of argument.

Intriguingly, the epistemic difficulty that afflicts all strategies of design inference emerges very clearly in the context of another version of the fine-tuning argument. George N. Schlesinger attempts to infer the existence of God from the appearance of a fine-tuned universe on the strength of a distinction between two different types of improbability.[6] An event is *benignly improbable* if and only if it doesn't warrant an inference that an intelligent agent has deliberately intervened for the purpose of bringing it about. Thus, for example, the event consisting of John's winning a 1-in-1,000,000,000 lottery game is benignly improbable; it is epistemically reasonable, other things being equal, to conclude that John simply got lucky. In contrast, an event is *suspiciously improbable* if and only if its occurrence warrants an inference that an intelligent being deliberately intervened for the purpose of bringing it about. For example, if John wins three consecutive 1-in-1,000 lotteries, we are warranted in inferring that someone deliberately intervened for the purpose of ensuring that John wins each of those lotteries. Despite the fact that the probability of winning three consecutive 1-in-1,000 games is exactly the same as the probability of winning one

1-in-1,000,000,000 game, the former event is *of a kind* that warrants an inference of intelligent design.

Schlesinger attempts to infer the existence of God as follows. Notice that the instantiation by this universe of the two to three dozen fine-tuned properties can plausibly be analogized to our having won approximately two to three dozen highly improbable lottery games. Thus conceived, then, the improbability of life in this universe is suspicious in exactly the same sense that John's winning three consecutive 1-in-1000 lottery games is suspicious – only very much more so. Thus, the argument goes, we are justified in, so to speak, inferring the existence of a divine 'cheater'[7] who arranged things to ensure that there would be life in the universe.

Though Schlesinger's argument is both beautiful and remarkable for its ingenuity, it is no less problematic. Schlesinger attempts to avoid having to calculate the prior probabilities of the Theistic and Atheistic Single-Universe Hypotheses by arguing that the appearance of fine-tuning is an event *of a kind*, for which an explanation making reference to intelligent design has a considerably higher prior probability than any other explanation. But notice that the design inference is epistemically appropriate in the context of John's winning three consecutive lotteries *only because* we know two additional facts that are relevant: (1) there exist people who have a motive to cheat in such events; and (2) such events occur more frequently than they would if determined by chance. Claims (1) and (2) provide the reason for thinking that someone's winning three consecutive lotteries is of a kind that warrants a presumption of intelligent design. It is only because we have this information about the prior probabilities of the relevant form of intelligent life that the design inference has additional epistemic force in this context.

Accordingly, assuming that the epistemic force of the other arguments for the existence of God is indeterminate, the problem with this lovely argument is that we simply don't have the necessary background information about prior probabilities that would enable us to employ Schlesinger's design inference. In particular, we don't have prior reason to think there exists an intelligent being that has the ability and motivation to bring into existence a universe that contains life. As a result, we don't have the necessary background information to characterize the improbability of a fine-tuned universe as suspicious and hence lack the appropriate background information that is an epistemic prerequisite for an application of a design inference strategy.[8]

The other design arguments for God's existence are in exactly the same position as Schlesinger's version of the fine-tuning argument. The reliability of design inferences in this world is explained by the fact that these inferences are made in a context in which we know that the prior probability of the relevant form of intelligent life is very high. Consider the following example, which William Dembski offers in support of design inferences:

A standard trick of statistics professors with an introductory statistics class is to divide the class in two, having students in one half of the class each flip a coin 100 times, writing down the sequence of heads and tails on a slip of paper and having students in the other half each generate purely with their minds a 'random looking' string of coin tosses that mimics the tossing of a coin 100 times, also writing down the sequence of heads and tails on a slip of paper. When the students hand in their

lists of sequences, the professor must sort them into two piles, those generated by flipping a fair coin and those concocted in the students' heads. To the amazement of the students, the statistics professor is typically able to sort the papers with 100 percent accuracy.[9]

As Dembski explains, the reason for the professor's accuracy is that she simply looks for a repetition of six or seven heads or tails in a row to distinguish those sequences that are genuine from those that are fabricated. The professor knows that people generally alternate between heads and tails too frequently when they are trying to fabricate random sequences of coin-flip outcomes. Thus, she can infer 'design' in sequences of outcome that alternate too frequently between heads and tails.

But notice that this empirical background information is absolutely crucial in warranting a design inference. After all, the probability of any one of these sequences is exactly the same as any other – namely $1/2^{100}$; thus, from a purely mathematical point of view, each of the genuine sequences is as astronomically improbable as each of the fabricated sequences. What makes it possible for the professor to assign a higher probability of design to the fabricated sequences is that she *knows* that half of the students are trying to fool her – information that, in each instance, goes towards determining the prior probabilities of a design hypothesis *in any given case*. In the absence of this kind of information, however, the epistemic force of the design inference drops catastrophically.

Similar things, of course, can be said about the arrangement of the rocks in the form of 'Ken was here'. In the absence of any background information about the relevant prior probabilities, every arrangement of those rocks within that particular region of ground is as astronomically improbable as the arrangement in the form of 'Ken was here'. How much epistemic force the design inference has depends on what *other* information we have at our disposal. If we are close to Earth, say, the prior probabilities of intelligent design go way up, making the design inference all the more forceful. If we are not close to a planet that we know can support life, our confidence in the design inference diminishes accordingly.

Indeed, Schlesinger's and Dembski's examples point us in the direction of an interesting observation about design inferences. Design inferences are typically used to enable us to distinguish what is *done* from what *merely happens*. In both the cheating example and the statistics example, we are not attempting to infer the *existence* of an intelligent agent. Rather, what we are doing is trying to show that the best causal explanation for a particular state of affairs is that some intelligent agent brought it about. In their prototypical use, design inferences help us to identify intelligent behaviour – which can, of course, help us to come to understand other things in the world.

Thus conceived, if we already *know* that God exists, then design inferences would provide reliable information about how to make sense of the world and about what God wants for the world. In that set of epistemic circumstances, for example, the occurrence of fine-tuned properties would provide a very good reason to think that God (whose existence has already been independently verified) deliberately structured the world to support life. Likewise, what Dembski, Michael Behe, and others identify as irreducible complexity in the world would provide a very good reason to think that God, so to speak, helped evolution alone.[10] And this sort of

information about God's behaviour would enable us to come to understand quite a bit about what God values and hence help us to identify what God wants from us.

In fact, though intelligent design proponents sometimes seem to think otherwise, design inferences are common in the empirical sciences. To name just a few, psychologists, sociologists, anthropologists, zoologists, and criminologists all explicitly rely on design inferences. But the role of the design inference in these contexts is to identify and understand intelligent behaviour – and not to show the existence of intelligent agency.

What intelligent design theorists want, of course, is for the sciences to incorporate a certain kind of design inference – namely, one that attributes certain empirical complexity to the agency of an omnipotent God. The problem, however, is that, as a matter of scientific methodology, there is no ground for *standardly* employing these sorts of inferences in the absence of reasonably compelling reason for thinking that such a being exists and operates in the world. Indeed, if we knew that God exists, then scientists would be *obliged* to incorporate the design inferences since, as we just saw, design inferences are not only appropriate, but methodologically *required* in other empirical contexts where we know the appropriate agency exists.

This suggests, then, that the epistemic force of design inferences critically depends on our having a reliable sense for the prior probabilities of intelligent agency. In the absence of any such knowledge, we have no reason to think such inferences are plausible – though it is hard to put ourselves in an epistemic position in which we can see this. And, as far as I can tell, proponents of design inference have offered no compelling reasons to think that such inference strategies, in contrast to *modus ponens*, are based on some a priori principles that have universal application across possible worlds without regard to other features of that world.

What this means, however, is that the Cumulative Design Strategy is vulnerable to the same worries as any other design argument considered in isolation. The Cumulative Design Strategy attempts to avoid the problem of having to assess the prior probabilities of the Theistic Hypothesis by putting all of the design arguments together. But the need for an assessment of the prior probabilities of the Theistic Hypothesis can't be alleviated this way. If the reliability of each of these design principles is conditioned upon having certain background information about the prior probabilities of the Theistic Hypothesis, then the reliability of all of them, taken together, is also conditioned on that background information. One design argument can't provide the relevant background information for another design argument. For this reason, the Cumulative Design Strategy fails to justify the claim that God's existence is more likely than God's non-existence.

What the Confirmatory Argument *Does* Accomplish

Nevertheless, this should not be construed as denying that evidence of relative probabilities can be epistemically significant when prior probabilities are unknown. In this connection, it is important to realize that in many instances the prior probability of a hypothesis rightly includes evidence of relative probabilities. Suppose, for example, that at time *t1* scientists propose a novel hypothesis H1 entirely on the

strength of theoretical considerations. In evaluating the probabilities of H1 and H2 relative to observations O1, ..., On at some later time *t2*, the prior probabilities of the two hypotheses will be determined largely on the strength of theoretical considerations – assuming there is sufficient evidence to determine them. But if at some later time *t3* scientists wish to determine the relative probabilities of H1 and H2 with respect to a new observation On+1, the prior probabilities of H1 and H2 will be determined by evidence that includes the relative probabilities with respect to O1, …, On. In scientific matters, a substantial set of well-established relative probabilities invariably becomes part of the background information against which prior probabilities are assessed. It is characteristic of scientific knowledge that it tends to be dynamic in that very respect.

This suggests that, if nothing else, the Confirmatory Version of the fine-tuning argument provides a reason for believing the Theistic Hypothesis – though this reason falls well short of being a strong reason. Since it is clear that prior probabilities provide reasons for belief and the relative probabilities of two hypotheses at one moment figure into the determination of the prior probabilities of the two at some subsequent time, it follows that a comparison of the relative probabilities of two hypotheses, by itself, provides a reason to prefer the one with the higher relative probability. Thus, a comparison of the relative probabilities of the Theistic and Atheistic-Single Universe Hypotheses falls well short of warranting or justifying acceptance of the Theistic Hypothesis; such a comparison makes it *rational* to believe the Theistic Hypothesis. Given the view of many scientifically-minded persons that theism is irrational, this is certainly a worthwhile result.

Notes

1 I am grateful to the participants of the Symposium on Science, Philosophy, and Religion, which was held in May 2002 at the University of Toronto. I am especially indebted to John Leslie, Phillip Wiebe, and Klaus J. Kraay for their helpful comments. Some of the material in the first five pages of this article first appeared in Kenneth Einar Himma, 'Prior Probabilities and Confirmation Theory: A Problem with the Fine-Tuning Argument', *International Journal for Philosophy of Religion*, 51/4 (2002): 175–94, at 175–80. It is reprinted here with kind permission of Kluwer Academic Publishers.

2 One might think that if the relative probabilities of two hypotheses are equal under PC, then recourse to prior probabilities is epistemically appropriate in breaking that tie. But notice that treating prior probabilities as a tiebreaker will not help with the lottery example because the two lottery hypotheses are not tied under PC. As will be recalled, if an omnipotent, omniscient God intervenes to ensure that John's lottery numbers are drawn (i.e., if H1 is true), it is virtually certain that he will win the lottery; thus, the probability that John wins the lottery given the truth of H1 is 1. In contrast, if the winning lottery numbers are randomly selected (i.e., if H2 is true), then the odds of John's winning the game is 1 in 7,000,000; thus, the probability that John wins the lottery given the truth of H2 is 1 in 7,000,000. Since H1 is a clear winner under PC, there is

no tie to be broken. Thus, to the extent that consideration of prior probabilities is relevant only to break ties under PC, prior probabilities are irrelevant with respect to the lottery example.

3 Robin Collins, 'A Scientific Argument for the Existence of God', in Michael J. Murray (ed.), *Reason for the Hope Within* (Grand Rapids, MI: William B. Eerdmans Publishing Co., 1999), p. 53.

4 See, e.g., Michael Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution* (New York: Touchstone Books (Simon & Schuster), 1998).

5 At the very least, a different kind of argument will be needed to support this conclusion from the ones that are usually offered. For example, William Dembski argues as follows: 'In every instance where the complexity-specification criterion attributes design and where the underlying causal story is known, it turns out design is actually present; therefore design actually is present whenever the complexity-specification criterion attributes design. The conclusion of this argument is a straightforward inductive generalization. It has the same logical status as concluding that all ravens are black given that all ravens observed to date have been found to be black.' William A. Dembski, *Intelligent Design* (Downers Grove, IL: Intervarsity Press, 1999), p. 142. The problem with this argument is that an inductive generalization over this world cannot tell us anything about other logically possible worlds. In the absence of a convincing argument that establishes the possibility of a design inference across possible worlds, we have no grounds for thinking we can reliably apply design inferences in the thought experiment described above. I am grateful to one of the participants at the symposium for having pointed out the need to make this point.

6 George N. Schlesinger, *New Perspectives on Old-time Religion* (Oxford: Clarendon Press, 1988), pp. 124–48.

7 I mean this in a completely neutral way.

8 Thus, what this implies is that the distinction between suspicious and benign improbabilities is an empirically grounded distinction, and *not* a distinction grounded in just mathematical theory.

9 Dembski, *Intelligent Design*, p. 135.

10 But it is absolutely crucial to realize that such complexity is not inconsistent with evolution. Intelligent design proponents sometimes argue to the contrary: 'An irreducibly complex system cannot be produced … by slight, successive modifications of a precursor system, because any precursor to an irreducibly complex system that is missing a part is by definition nonfunctional … Since natural selection can only choose systems that are already working, then if a biological system cannot be produced gradually it would have to arise as an integrated unit, in one fell swoop, for natural selection to have anything to act on.' Michael Behe, *Darwin's Black Box*, p. 39. There is nothing in Darwin's view that entails that a trait can be selected for if and only if it increases the survival fitness of the organism. Traits that slightly detract from fitness could be naturally selected for if nomologically linked to a trait that increases fitness to a great extent. Thus, there is nothing in natural selection that precludes selecting

for a series of non-functional traits that culminate in something functional.

It is true, of course, that there is a greater improbability of such traits. But, in the absence of information about the prior probabilities of God's existence, the higher improbability is insufficient to justify the application of the design inference. *If we had independent reason for thinking God exists*, then that would be a reason to think that, given the unusually large improbabilities of the relevant selection, God has intervened to guide natural selection.

PART III
Naturalism and the Non-Natural

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Chapter 9

On Scientific Explanations of God-Experiences

Jerome Gellman

In recent decades, two types of defence have emerged for a positive epistemic valuation of alleged experiences of God. One, championed by William Alston, is the 'doxastic practice approach', that seeks to legitimize an established social practice of one's taking certain experiential input as God appearing to one. Another, advanced by a number of philosophers, including myself, the 'argument from perception', trades on a purported epistemic analogy between experiences of God and sense-perceptual experiences.

The 'scientific response', as I shall call it, counters these epistemological approaches in the name of scientific explanations of alleged experiences of God. A current lively branch of the scientific response is the neuroscientific response. The neuroscientist, V.S. Ramachandran has asserted flatly that as far as neuroscience is concerned, 'it can neither be proved or ruled out on empirical grounds' that God really does appear to people.[1] In what follows, I will argue, contra Ramachandran, that, in principle at least, neuroscientific findings could make it quite unlikely that God-experiences were veridical. To show this, first I will set out the requirements for any successful scientific reduction of God-experiences. Then, for illustration, I will look at a leading current neuropsychological theory of mystical experiences, that of Eugene d'Aquili and Andrew Newberg[2], and explain why it fails to generate reductionist conclusions. Finally, I will explain what it would take for a successful neuroscientific reduction of God-experiences. Throughout I will relate to the scientific response as an argument against accepting a theistic interpretation of alleged God-experiences, rather than as an attempt to explain such experiences after we have already discarded their theistic interpretation.

I distinguish two scientific approaches, 'truth-reductionism' and 'evidence-reductionism'. 'Truth reductionism', or 't-reductionism', argues that alleged experiences of God are illusions, that a subject does not really experience God. Evidence reductionism, or 'e-reductionism', seeks only to undermine the claim that an alleged God-experiences counts in favour of its own validity. If e-reductionism is right, we have little or no reason for thinking subjects really do experience God, but also no reason to think that they don't.

The reductionist proceeds by first determining a set of naturalistic circumstances, N, such that all or most persons who allegedly experienced God were in at least one or another circumstance included in N. Next, the reductionist would show that being in an N-circumstance was causally related to the having of allegedly theistic mystical experiences. The reductionist will assert that generally when a person is in an N-circumstance, this will cause the person to have a God-experience.

To start with, then, the reductionist maintains that:

(1) There is a set of naturalistic circumstances, N, such that all (or most) subjects who have alleged God-experiences are in some N-circumstance, and being in an N-circumstance causes a person to have seeming God-experiences.

The t-reductionist will want N to be such that from (1) she can reach the conclusion:

(T) That an alleged experience of God occurs in an N-circumstance is a reason to believe the experience illusory.

The e-reductionist will wish (N) to be such that from (1) she can get to:

(E) That an alleged experience of God occurred in an N-circumstance is a reason to believe that it would have occurred even had it been illusory.

To get from (1) to (T) or (E), however, a reductionist would have to show in addition that being in an N-circumstance was not a reason to think that experiences of God *would be* veridical. To illustrate the point, suppose we discovered that everyone who had an alleged theistic experience had an obsessive need to experience God. Suppose, further, that an e-reductionist offered this as a naturalistic cause of the experience. This would not suffice to show that either (T) or (E) were true. This is because, for all we would, know people's strong desire to experience God was answered by God's decision to really appear to them. These are just the kind of people to whom God might choose to appear. To be successful, therefore, an N-circumstance must not provide a reason for thinking a God-perception was indeed veridical.

Furthermore, the reductionist must provide reason to reject the following:

There exists a set of naturalistic circumstances, N1, *in addition to N*, such that most persons who seem to perceive God are in an N1-circumstance, and being in an N1-circumstance is a good reason to think they would have authentic God-perceptions.

To illustrate, suppose we discovered that most subjects who reported perceptions of God had been longing to experience God. Suppose further we had a well-grounded causal generalization taking us from people longing for unusual experiences to their subsequently having them. By itself, this would *not* establish even the evidence-reductionist position, since in addition the same people may have been in an N-circumstance that supports the hypothesis that their experiences *were* veridical. Suppose we discovered they had all undergone years of serous spiritual training, that in other contexts when they had strong desires for unusual experiences they never made analogous claims, that they were all level-headed, sober, conservative folk, and so on. This finding would cancel the force of having discovered that these subjects had been in the proclaimed N-circumstance when allegedly experiencing God.

Reductionists, then, must give reasons for thinking there were no additional N1-circumstances supportive of the theistic explanation of perceptions of God.

To sum up, the scientific response, (R), should include all of the following claims:

1. There is a set of naturalistic circumstances N, such that all (or most) subjects who allegedly perceive God are in some N-circumstance;
2. Being in an N-circumstance gives reason to expect or suspect those subjects would have had alleged God perceptions, even if their perceptions were illusory (e-reductionism), or being in a N-circumstance gives reason to expect or suspect those subjects had illusory God-perceptions (t-reductionism);
3. There is no set N1 of naturalistic circumstances, such that: all (or most) subjects who allegedly experience God are in some N1-circumstance and being in an N1-circumstance counts significantly in favour of the subjects having had veridical experiences of God; and
4. A person's being in N does not give reason to expect or suspect the person's perceptions would be veridical, if God existed.

Reductionist Strategies

Reductionists have available two possible strategies for grounding their reductionist programme, as expressed in (R). The first would be to employ a generalization from an enumeration of known cases of alleged God-experiences to the truth of (1). The second would be to motivate (1) theoretically.

Classical inductive strategies seek documentation of alleged God-experiencers having suffered from pathological conditions, such as severe deprivation, severe sexual frustration, intense fear of death, pronounced maladjustment or mental illness. Or else they try to establish non-pathological causes, such as hyper-suggestibility, infantile regression, wish fulfilment, or a religious psychological set. The strategy then generalizes from documented cases to establish (1). These strategies, however, do not succeed very well. The phenomenon of alleged God-perceptions has been so varied over history, cultures, personalities, and personal circumstances that a convincing generalization of these sorts is hard to come by. Pathological conditions are not a plausible candidate for the N-set since the phenomenon of alleged God-experiences includes garden-variety mysticism in prayer and contemplation, and plenty of 'professional' mystics who seem quite free of pathological conditions. As for non-pathological conditions, no one has ever given a convincing argument that these can cause God-experiences. We have here speculation rather sound induction.

A further problem is that it is an open question whether pathological conditions fulfil clause (4) that a person's being in N does not give reason to expect the person will have veridical experiences of God, if God exists. People suffering greatly inwardly might be just the kind of people God would grace with a sense of the living Divine presence. An experience of God would be comforting and reassuring and could help a person to begin leading a happier, more fulfilled life.

Finally, reductionists would also have to establish the truth of (3), that there was no additional N1-set that counted in favour of God-experiences being genuine. Not only have reductionists of the present type not done this, it is also hard to see how they *could* do this in a plausible inductive way.

The second naturalistic strategy proceeds from theoretical reasons why we should not accept the theistic explanation of alleged experiences of God. The main

theoretical advantage to be gained by alternative explanations lies in their ability to explain a far wider array of empirical findings than can the theistic explanation.

This strategy divides into a wide and a narrow one. The wide strategy favours naturalistic explanations over theistic ones because, as a general policy, the former explain more than the latter. The narrow strategy favours a naturalistic explanation for the local issue at hand. It is in this context that I now turn to the neuroscientific theory of Eugene d'Aquili and Andrew Newberg (*The Mystical Mind*).

A Neuroscientific Explanation

D'Aquili and Newberg propose the prefrontal area of the brain, especially the lateral convexity of the frontal lobe, as the locus of brain activity during mystical episodes. The theory proposes mystical states as involving 'deafferentiation' or the cutting off of neural input into this area of the brain. The theory begins by relating to both 'passive meditation' and 'active meditation'. Passive meditation is characterized by the intent to clear the mind of content, as much as possible. This sets off an intricate system of deafferentiation within the brain that 'results in ecstatic and blissful feelings via intense stimulation of structures both in the lateral hypothalamus and in the median forebrain area'. A consequent neutralizing of the posterior superior parietal lobule, responsible for spatial co-ordination of incoming stimuli, creates a sense of 'pure space' experienced as absolute unity. Patterns set up in the brain in passive meditation create an overwhelming experience of 'absolute unitary being'. At this point two alternative continuations are possible, depending on how impulses sent out from the involved brain structures affect other parts of the brain, particularly the limbic structures. In one alternative, a reinforcing of the lateral hypothalamic discharge reinforces the initial ecstasy of the experience, and on the other, the initial ecstasy is followed by a 'deep and profound quiescence' by a return to dominance of the ventromedial hypothalamic structures. A subject interprets ecstasy as God-experience, while the quiescent route is interpreted an experience of an impersonal emptiness or ground of being.

In 'active meditation', a subject intends to focus on a mental image or on an external object. The d'Aquili–Newberg theory describes a brain-story somewhat similar to that for passive mediation, resulting in the falling away of the subject-object distinction and the emergence of a mystical experience.

Finally, the theory attends to 'lesser mystical states', including those that occur spontaneously, without meditative preparation. D'Aquili and Newberg posit that in lesser mystical states we are dealing with 'mild to moderate' stimulation of certain circuits in the lateral hypothalamus. This generates a mild to moderate fear accompanied by a sense of exaltation. This is the complex of 'religious awe'.

D'Aquili and Newberg caution against a reductionist reading of their theory, saying that 'we need to maintain an attitude of humility, rather than of arrogant presumption that our knowledge of neurophysiology can give us intrinsic knowledge of the relationship between "reality" and consciousness.' That is, d'Aquili and Newberg allow that something – some 'X', as it were – rather than nothing, might, for all we know, serve as an object of mystical experiences.

Nevertheless, their theory has clear reductionist import. It explains away any specific description of 'X', including X's being God. The theory posits that activating of the appropriate structures for particular emotions determine whether subjects think they are experiencing God, or something else. 'Godness' is no part of the phenomenology of the experience. In 'lesser experiences', subjects simply interpret a complex of emotions as a theistic experience. At best, an experience is of an amorphous 'reality', all the rest supplied by the brain. So, the theory carries reductionist weight against thinking that God, in particular, is the object of theistic experiences.

The strength of the theory of deafferentiation lies in its ability to explain a variety of experiences. It explains both theistic and non-theistic experiences and meditative and non-meditative experiences. In an elaboration of the theory, d'Aquili and Newberg explain a continuum of aesthetic, spiritual, and mystical experiences, giving their theory power to explain an even more impressive variety of experiences.

An objection to the theory from a phenomenological point of view would be that it fails to take seriously enough the alleged perceptual-like character of some experiences of God. At least some God-experiences are thought to have a subject-object structure, in which a subject senses being 'appeared-to'. The theory, however, treats these experiences as a cluster of subjective feelings waiting to be interpreted by the subject. D'Aquili and Newberg seems to miss this feature of at least some claimed God-experiences.

Suppose, though, that d'Aquili and Newberg were able to improve their theory to accommodate this objection. Perhaps they would discover a mechanism that goes from the cluster of emotions to an experience marked by a subject-object phenomenology. At that point, we may wish to reply that the improved theory merely describes how God gets into a person's consciousness. We should have expected, after all, that a non-sensory perception of the sort God-perceptions purport to be would involve unique brain events. A theory can do no more than tell us what happens in the brain when a mystical experience of God takes place. It cannot tell us this happens while God is not really appearing to the subject or that an explanation in terms of brain-processes defeats a theistic explanation. Therefore, we should reject any attempt to conclude that the ultimate cause for a theory's favoured brain-events is altogether internal to the organism and internal especially to the brain.

This immediate response fails to take into account a serious difference between physical object perceptions and God-perceptions. In the case of sensory perception, we have clear evidence for the existence of a cause originating from a point external to the brain. Take vision. We can trace the impinging of light onto the retina from outside the organism, follow the impulses through the ganglion cells that converge on the retina, onward to the optic nerve, on to the optic tracts of the posterior part of the forebrain, and so forth. We thus possess clear empirical grounding for a visual stimulus outside the brain. The same holds for our other sense modalities.

No such story exists for God-perceptions. We have no parallel neuropsychological story about how God gets into the organism and the brain. The theory does not posit 'God receptors' analogous to the retina. A theistic interpretation of God-perceptions thus lacks cohering empirical backing for the validity of its perceptions that sensory perceptions enjoy. The reductionist pressures abide.

Here is a reply to this reply to the immediate response: The absence of 'God receptors' does not count in favour of replacing the theistic understanding of God-experiences with our neuropsychological explanation. Perceptual receptors that feed into the brain are to be expected and sought for when dealing with a physical stimulus, but not with a non-physical stimulus like God. Physical stimuli are at a physical distance from the brain and so we need receptors to carry the stimuli, physically, to the brain. God, however, does not exist at a physical distance from the brain. Furthermore, God can act directly upon the brain to bring about the relevant processes for a subject to experience God. Therefore, the absence of God-receptors analogous to sensory receptors does nothing to enhance the reductionist force of the neuropsychological explanation of mystical experiences of God. We remain with the previous point that a story about what happens in the brain during God-perceptions does not have the power to undermine the theistic understanding of those perceptions.

I believe this objection to be correct. However, the theistic defender should not exaggerate the victory. All the argument shows is that not just any neuropsychological explanation has reductionist power. I can envisage a theory of this category that would be seriously damaging to a theistic understanding of God-experiences. To see this, recall how truth-reductionists, who deny the validity of God-experiences, would typically argue. They would argue that there was a set of naturalistic circumstances N, such that all (perhaps most) subjects who allegedly experienced God were in some N-circumstance, and that being in an N-circumstance gave reason to expect that subjects had inauthentic God-perceptions. As long as there were no additional circumstances that counted in favour the veridicality of God-experiences, and provided that a person's being in N did not give reason to suspect the person's perceptions would be veridical, we should conclude that the experiences were *not* veridical.

Here is an example. Suppose we discovered that all people who had mystical experiences of God had taken mescaline before their experiences. It does not square with God's alleged character that God would appear to all and only people who had taken mescaline. Nothing singles out mescaline users for the special treatment implied by their having really experienced God. Hence, given the fulfilment of the other conditions in the reductionist's argument, people who seemed to perceive God most likely did not have veridical perceptions of God, although they might have had, for all we know, an experience of some mystical reality.

Similarly, there could be a neuropsychological account of alleged mystical experiences of God that made it implausible to believe people really had experiential contact with God, given God's alleged character, and of that being the way God would choose to reveal to human beings. The brain mechanisms would be of a sort we should expect not to exist were the experiences veridical. For a far-fetched example, suppose researchers discovered that God-experiences were always dependent on a brain abnormality caused by people, appropriately genetically disposed, eating an excessive amount of spinach in early childhood. Such a discovery would provide implausible necessary conditions for mystical experiences of a being of the sort God is supposed to be. Supposing we had supplemental theories for the other conditions for a successful reductionist explanation, we should conclude that it was unlikely that people had veridical God-experiences.

Now, the d'Aquili–Newberg theory introduces no neuropsychological mechanism that would be an implausible candidate for how God gets into the brain, given God's nature. The same applies to other current theories, such as that of Batson, Schoenrade, and Ventis, and the theory of Michael Persinger.[3] Further research into the neuropsychology of these experiences might produce a plausible reductionist account. So while present neuropsychological theories don't do the job, we should reject Ramachandran's declaration that neuroscience could not rule out on empirical grounds that people have veridical experiences of God.

Notes

1 See V.S. Ramachandran and Sandra Blakeslee, *Phantoms in the Brain*: *probing the mysteries of the human mind* (New York: William Morrow, 1998), p. 182.

2 Eugene d'Aquili and Andrew Newberg, *The Mystical Mind: probing the biology of religious experience* (Minneapolis, MN: Fortress Press, 1999).

3 See C. Daniel Batson, Patricia Schoenrade, and W. Larry Ventis, *Religion and the Individual, a social-psychological perspective* (Oxford: Oxford University Press, 1993; see also Michael A. Persinger, *Neuropsychological Bases of God Beliefs* (New York: Praeger, 1987).

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Chapter 10

The Human Genome Revolution, Society, and Religion

Job Kozhamthadam

The twenty-first century can rightly be considered the era of science. This is so because today we are witnessing not only a quantitative but also a qualitative growth of science: quantitative because every day findings are being added to the already overwhelming list of discoveries and inventions; qualitative because the path of science seems to be taking a new course. Thinkers are pointing out that today science is moving from an age of discovery of nature to an age of mastery of nature. In the past, scientists were pleased and felt fulfilled when they succeeded in revealing the 'secret' laws of nature. Today, they seem to be far more ambitious: they want to have mastery over the operations of nature; they want to have a hand in determining the destiny of nature.

Perhaps this transition from discovery of to mastery over nature is best illustrated in the case of the Human Genome Project (HGP). As John Sulton, director of Sanger Centre in England, said soon after the 'working draft' of the human genome was made public on 26 June 2000, 'we've now got to the point in human history where for the first time we are going to hold in our hands the set of instructions to make a human being. That is an incredible philosophical step forward, and will change, I think, the way we think of ourselves.'[1] In the case of the HGP, the qualitative change expresses itself in another way as well: hitherto, the discoveries of science concerned themselves with the world around humans, but the HGP touches human persons themselves; hitherto, science dealt with the conditions of life, but in the HGP it deals with life itself; hitherto, science focused on what humans have and want to have, but in the HGP it focuses on what human are and can be. This is so because the human genome is indeed the book of human biological life. The ordering and operation of the over three billion chemical units of the human genome seem to contain the entire secret of a human being's biological life. This paper is a brief study of some important aspects of the HGP and some of its social and religious implications.

Some Important Preliminary Concepts and Developments

To understand the HGP, we need to have some idea of the basic constitution of the human body. Perhaps the point of departure could be the cell, the basic unit of biological life, the smallest unit capable of supporting and sustaining life. The human body has about one hundred trillion of them existing in about two hundred different forms. The cell has two primary parts: the nucleus and cytoplasm. Although both of them are important, we focus on the nucleus since it is here that the main

actors of the genome drama – DNA, genes, and chromosomes – are housed. DNA (deoxyribonucleic acid) has three fundamental constituents: a phosphate molecule, a sugar molecule, and a base molecule. The three components are linked together by chemical bonds in the order of phosphate-sugar-base, and this combined unit is called a nucleotide. The four bases occurring in DNA are identified as Adenine (A), Guanine (G), Cytosine (C), Thymine (T). DNA is made of a large number of nucleotides strung together like beads in a necklace.

Genes and chromosomes are also important items in this discussion. They are responsible for the different characteristics of the individual, such as colour, size, texture, and so on, and remain unblended under cross-breeding. Chromosomes are small threadlike structures carrying genes. When a new offspring is produced, the male and female parents contribute the same number of chromosomes, and there is a fixed number of them in each cell.

After a long and arduous search for the structure of DNA, in 1953 Francis Crick of England and James Watson of the USA discovered that DNA was made up of two long helically entwined chains (the double helix). But once the structure of DNA had been correctly identified, scientists wanted to go further to investigate its deeper significance. For instance, they began asking whether the intricate order and arrangement of this giant molecule of DNA carried some special significance or message, particularly with regard to the transfer of information from cell to cell in order to carry out life activities like the production of the life-sustaining proteins.

The possibility that DNA with the genes could be the carrier of the genetic code was first proposed by Erwin Schrodinger in 1943. He argued that the gene had a special molecular status. It could be looked upon as an aperiodic crystal, capable of storing a large quantity of information. He suggested that ‘a chemical code could be embedded in the gene. He saw the aperiodic crystal as a long, linear molecule made up of small units (which we now know to be nucleotides), which acted as the “letters” of this chemical code.’[2] According to Schrodinger, ‘with the molecular picture of the gene, it is no longer inconceivable that the miniature code should precisely correspond with the highly complicated and specific plan of development and should somehow contain the means to put it into operation.’[3] Another physicist, the Russian-born George Gamow, came up with the idea that the bases could work as a four-digit code. In his view, the order or sequence of the bases in an organism’s DNA is ‘the signature of the beast’, somehow encoding all its characteristics.[4]

By now it was becoming clear that DNA encodes the acid sequences of proteins. But how can just four bases or chemical units be linked to the 20 amino acids found in proteins? Obviously, the ‘one base, one amino acid’ formula would not work. By 1961 Crick and the South African microbiologist Sydney Brenner gave experimental proof that the code was made up of non-overlapping triplets. This combination of three bases was called codons. These ideas gave rise to a new definition of the gene: a stretch of DNA that codes for a particular protein. For instance, the enzyme amylase is a protein which breaks down starch molecules in bread. The gene for this is a segment of DNA that codes for its amino acid sequence.

The Human Genome Project (HGP)

The Basic Idea

Human biological life can be compared to a book – 'the book of life'. It is written in a language made up of four alphabets, A (Adenine), G (Guanine), C (Cytocine), and T (Thymine), which are biochemical units known as bases. Genes are the words formed by these letters. Genes are primarily responsible in determining how humans will be, what characters they will have, how they will carry out their essential functions, and so on. Each gene controls a particular characteristic of the organism. These genes are carried by chromosomes. The human cell has 23 pairs of chromosomes. Although when the 'rough draft' was announced, it was believed that the human genome had about 100,000 genes, the most recent research puts it at 30,000.

The human DNA consists of a long chain of bases (A, G, C, T), repeated over 3.1 billion times in varying combinations. This sequencing is not arbitrary or random. Indeed, as has been mentioned already, it contains absolutely vital instructions and information for sustaining life, since it is this that determines the production of the all-important proteins. This code can be compared to the Morse code used in telecommunications, which when decoded or translated conveys important messages. The human genome project consists in identifying the order or sequence of these chemical units and mapping their location in the 23 pairs of chromosomes. In terms of the above analogy of the book of life, 'the genome sequences is like a complex instruction manual of genes that governs human biological functions from the moment of conception to death.'

DNA and genes play a crucial role as carriers of genetic information for producing proteins which play a crucial role in determining all the biological aspects of a living organism. Details like the colour, shape, texture, and so on of the different organs of the body are determined by the numerous proteins. Coded instructions for producing these proteins will require a complex structure to be their carrier. Since DNA is a complex giant-molecule made up of billions of component parts or sub-units, it is capable of storing such a massive quantity of coded instructions. It follows, therefore, that the genome is the complete info-mass in a human body.

Some Important Past Developments in Genome Research

The HGP can be looked on as the culmination of several important developments of a similar nature, but involving lower animals. For instance, the genomes of several bacteria and of a few animals were determined in the past few years. In 1996 the yeast genome was sequenced, identifying 6,000 genes. In 1998 the genome of the nematode worm was deciphered. In March, 1999, the genome sequence of the fruit fly was completed. Scientists were also working on the mouse genome.

It must be noted that this work was an extremely valuable preparation for the HGP since the genes of these organisms, despite their low place in the ladder of evolution, show remarkable resemblance with the human genome. As Carl D. Johnson points out, 'Somewhere between 50 and 80 percent of the time, a random human gene will

have sufficiently similar counterpart in nematode worms or fruit flies, such that you can study the function of that gene.'[5]

Thus these organisms can be looked upon as model organisms. Their usefulness in the HGP can hardly be overlooked. It is found that '60% of the known human disease genes have equivalents in flies and that about 7,000 (50%) of all fly proteins show similarities to known mammalian proteins.'[6] In the case of the proteins of the nematode worms, roughly one third is similar to those of mammals. Thirty-eight per cent of all yeast proteins also show similarity with mammalian proteins. The mouse genome is even closer since more than 90 per cent of mouse proteins identified so far show similarities to known human proteins. Hence the successful work on the genomes of these lower organisms was a most welcome preface to the HGP.

The Organization of the HGP

The HGP was indeed a mega-project involving a large number of outstanding scientists from many countries with varied backgrounds and expertise. More than 1,100 top-level scientists from over 18 outstanding research centres spread over 6 nations, participated in this project.

The major partner in this venture was the National Human Research Institute, with its headquarters in Bethesda, Maryland, USA, and with Francis S. Collins as its current director. The Human Genome Project is a publicly funded consortium based in the United States, but collaborates with leading centres in England, Japan, France, Germany, and China. The other major partner was Craig Venter of Celera Genomics of Rockville, Maryland. A daring upstart in the race, he threatened to outsmart the public consortium by his innovative ideas and ability to get results at 'supersonic' speeds. Fierce competition between these two rivals had the salutary result of completing the project well ahead of time: the HGP began its operation in 1990 and was slated to complete the project in 2003 or later, but the 'working draft' was out in April 2000.

This project also saw the many branches of science coming together utilizing the most advanced hi-tech equipment in a spectacular and efficient collaboration. For instance, it used a recently developed high-throughput sequencing technique which makes use of robotics, automated DNA-sequencing machines and computers. It was reported that the sequencing machines could sequence daily up to 1,000 basic units from each end of a DNA segment; now it is even faster.

The Different Strategies and Steps of the HGP

The human DNA is a database – the most sophisticated, most complex, and most versatile database ever created. Before it can be studied and understood in detail, it has to be unpacked, its parts will have to be identified, and its ordering will have to be determined. The HGP is an important step in this direction.

The task of identifying the constituents of the human genome was literally a Himalayan task since each one of the over 30,000 genes on the average has about 1,000 nucleotides in it. The HGP had three principal tasks: 1. Identify all the (approximately) 100,000 genes. 2. Determine the sequence or ordering of the

3 billion odd chemical bases. 3. Store the information in databases. All these steps were carried out successfully by both the HGP and Celera Genomics, although each followed a different strategy.

Reflections on the HGP and its Implications

A Ground-Breaking Development

The preparation of the draft copy of the human genome is indeed a remarkable development with few parallels in the history of science. It is an important milestone along science's path to unravelling the mystery of the most intriguing being in the universe. Its enormous implications and the many possibilities it can open up will become clear only in the days to come. We know the discovery of antibiotics revolutionized medical practice, and the advent of X-rays transformed medical diagnosis. From the genome we can confidently expect an even more revolutionary outcome. Often this work is compared to developments in the physical sciences, like the cracking of the atom and the landing on the moon. In a recent interview Venter remarked: 'I think that, when history looks back on these papers and on this era, [the human genome project] will be viewed as having the same impact on humanity that Copernicus and Galileo had in hoping to show that the earth was not the center of the universe.'[7] However, there is a significant difference here: these feats touched humans from without, whereas the genome and related developments touch them from within. The former seem to influence what humans have and may need, whereas the latter influence what humans are and can be. Hence, the importance of these developments is enormous. We cannot remain passive onlookers of this drama unfolding before us.

An Unfinished Task

The high-profile publicity given by politicians and scientists, together with the glamorous coverage in the media, may (mis)lead one to believe that the final goal of the genome revolution has been attained. One might get the (false) impression that the mysterious code of life has been cracked, and that the human life is now an open book. But the fact remains that this is only the beginning. At best, the genome gives us only the sequence or ordering of the different components making up the human DNA. We also know that this ordering is pregnant with vital significance. But many more questions remain to be resolved. For instance, how does this ordering affect the various aspects of the life processes? How is this ordering influenced by the environment? What is responsible for this particular type of ordering? Scientists are pursuing these and similar issues, but it will be a long time before satisfactory answers come. Collins recently admitted that scientists do not 'really understand all of its [the human genetic code's] language, but we are beginning to derive some of its early lessons, and we are finding ourselves totally surprised'.[8]

It has been found that the actual genes and the bits of DNA controlling the on/off switch of the protein-producing activity of the genes, account for a mere 5 per cent

of the total DNA in the cell. The remaining massive chunk of 95 per cent is left out as 'junk' since at present science is unable to assign any definite function for it. It seems to me that the pejorative label 'junk' betrays more our ignorance than an actual fact, because nature has given us ample evidence that she does nothing in vain. This 'junk' is a challenge to future scientific research.

Furthermore, the history of science tells us that knowing the immediate structure is only a preface to grasping the inner nature of something. The splitting of the atom by Lord Rutherford at the beginning of the twentieth century was only the beginning of our knowledge of the atom. Today after a century of phenomenal breakthroughs in science, we are nowhere close to solving the mystery of material reality. We certainly have a far better idea of material reality today, but the final comprehension seems to remain as elusive as ever. Will such a fate befall our attempts to fathom the mystery of life in general, and human life in particular?

Knowing how the components of the genes are arranged and how this arrangement affects certain life functions is not the same as knowing what life is. Life is primarily the ability to sustain co-ordinated, continuous, and contextualized activities of an organism. Contextualization principally involves an organism's ability to interact with its environment. Genome research, as it stands now, is inadequate to handle the enormous complexity of life and life-activities. The specific structure of DNA and the sequencing of its components may be a necessary condition for life, but it is not sufficient to create life. The mystery of life still seems to elude science.

An even more significant observation is that the genome refers only to the biological aspect of humans. It deals with human life purely from a biological point of view. But a human person is far more than a biological organism. The psychological, social, religious, and spiritual dimensions of the person are also significant. The genome revolution leaves these aspects untouched. These and other questions yet to be answered should in no way detract from science's well-earned reputation. They only make a plea to our media-driven society to have a realistic view about what has been achieved.

Some Scientific Implications

Any outstanding development affects not only what science does but also what science is. For instance, Newton's discoveries in the eighteenth century transformed the science of the day. The same can be said of Einstein's contributions. The many developments in genetics and genetic engineering are changing the nature of science in significant ways.

A New Paradigm of Scientific Work: Recent developments in science in general, and in genetics in particular, reveal a paradigm shift in the way science is done: science as 'the activity of the genius in isolation' is changing to 'the activity of a community'. As we have discussed already, the genome project was an excellent example of international collaboration in science. This means that the sociological dimension can no longer be looked upon as merely peripheral or accidental. Indeed it is becoming clear that the future progress of science will depend considerably on the level and intensity of such a collaboration. Teamwork and active collaboration

cutting across geographical, racial, and cultural boundaries are being recognized as fundamental values in science as well.

Unity of Science: The human genome project was yet another testimony to the unity of science. In our world of super-specialization, it is important to remember that often breakthroughs in science are brought about by the synthetic or unified approach. In this project we see many different branches of science and many different technologies and techniques coming together to assist each other to make this venture a success. Biology, genetics, robotics, computer technology, genetic engineering, cloning, high-throughput sequencing, and so on, worked hand in hand in this project. The different branches of science, though diverse, reveal a deeper unity.

Unity of the Universe: The different discoveries in particle physics revealed the unity in diversity of the non-living world since, according to it, the whole material world is made up of the same fundamental particles such as protons, neutrons, and electrons. The genome project and related developments show this unity in diversity of the living world. Just as atoms of different material elements are made up of the same fundamental particles, the DNA of different beings is made up of the same kind of nucleotides. Even in the sequencing one can see a remarkable similarity. The genomes of the model organisms discussed earlier, like yeast, the nematode worm, the fruit fly, and the mouse, show remarkable similarity with the human genome. According to some estimates, humans share 98.4 per cent of their DNA with chimps. With cows the overlap or the DNA shared is 90 per cent, with mice 75 per cent, with yeast about 30 per cent, and with E. coli 15 Per cent. The human race has passed the six billion mark some time ago. Despite such large numbers spread over many continents, cultures, and races, humans show a remarkable and deep unity in their biology. It is found that any two individuals differ on the average only in one nucleotide per one thousand. Venter points out that 'genome research shows humans to be "clearly part of a biological continuum"'. In fact, according to him, 'if we showed you the mouse genome today, you would not be able to tell its difference from the human genome. There are very few changes.'[9]

Further Support for Evolution: Important data unearthed through genomic research clearly support evolution. The fact that the genomes of various levels of living beings show such striking similarity is a clear evidence for their common origin. As Susan Alridge remarks, 'with a few exceptions the genetic code is universal. Organisms as diverse as the bacterium *Escherichia coli,* higher plants and humans use the same DNA dictionary to translate the messages in their genes. This is one of the strongest proofs we have for the common ancestry of all life ...'.[10]

The fact that at the DNA level E. coli, yeast, and so on, have so much in common with humans shows that all living beings can be traced to a common source from which evolution emerged gradually, giving rise to different beings on its way. In fact, the overlap (that is, the percentage shared in common) between two different species can be used to estimate their relative age: the more the overlap, the less the age difference between them.

Genome and the Medical Sciences: No other area has been as affected by the genome revolution as the medical sciences, both qualitatively and quantitatively: qualitatively, a transformation in medical diagnosis and treatment is already afoot, quantitatively, cures to many serious diseases are being developed. It is well known that in medicine correct and timely diagnosis is more than half the solution. Again, the degree of success in medicine is directly proportional to the extent that the physician can eliminate guess work. A genome report can go a long way in reducing guess work in medical diagnosis and treatment. Since genomic information can identify possible problem spots, early and accurate detection and even prevention of diseases become possible. It also becomes possible to fight diseases at the molecular level rather than at a far more complex and risky tissue or organ level. The developments in genome research may bring about a paradigm shift from a treatment-based to a prevention-based medicine, with immense gains both monetarily and psycho-physically.

More specifically, it is reported that cancer research has identified more than 50,000 genes as related to some form of cancer.[11] According to other reports, genome research may bring a ray of hope to sufferers of more than 6,000 genetic diseases.

As expected, pharmaceutical giants are already very active in the field. Genes are responsible for the production of proteins that control the many aspects of life-activities. Since the malfunctioning of protein production leads to disease, predictions are that the 30,000 genes will open up possibilities for the production of more than a million proteins.

Some point out that 'gene therapy applied to treat ordinary body cells has so far been a failure'.[12] This is no reason for alarm, since science is never guaranteed to get things right in the first attempt, but it never gives up, and often succeeds in the course of time when better ideas and methods emerge.

However, not everything needs to be good news on the medical front. Collins points out that 'you will be able to have your own report card printed out of your individual risks for future diseases based on the genes you have inherited.'[13] But this kind of information need not always be a boon to humans, especially when the person is helpless to deal with the problems diagnosed. Foreknowledge about the possibility of serious genetic disease and premature death may become a source of tension and anxiety for the person. In situations like this ignorance may be a blessing in disguise. It may also be noted that all predictions made by medical science are only probabilistic, and so may not happen. Having a list of possible problems waiting to befall you some time in the future may not be a pleasant and peaceful way of living.

Some Philosophical Implications: Reductionism and Its Limits

The reductionist approach consists in reducing complex multiplicity to simple unity – to its simple components. Here analysis and explanation of a complex phenomenon are done by identifying the simplest components giving rise to it. For instance, atomic theory explains material phenomena in terms of the interactions between various atoms. The genome project is a paradigm case of the reductionist approach in the biological sciences aimed at unravelling the secret of life. It has moved from cell, to nucleus, to DNA, to nucleotides.

Despite being a powerful tool in science in analysing and understanding phenomena, reductionism has certain inherent problems, particularly when dealing with living organisms. It involves fragmenting a complex reality, detaching it from the rest. It is assumed that this detaching and isolation can be done without affecting the rest of the system. It also assumes that the whole is simply the sum of the parts. Both these assumptions are highly questionable, particularly in the case of living organisms, since life does not seem to be the mere aggregate of component parts.

Reductionism seems to make an even more radical assumption: that the human body can be looked upon as a machine. A complex organism like the human body can never be reduced to a machine, however sophisticated. As Collins aptly remarks, 'if humanity begins to view itself as a machine, programmed by this DNA sequence, we've lost something really important.'[14] Identifying the different components of the genome is indeed important and valuable, but equally important is an accurate knowledge of how the different components are related to each other, and how they fit into the whole organism.

In recent times several other scholars also have severely criticized the applicability of reductionism in biology. Mary Midgeley, Steven Rose, and John Cornwell are a few among them. According to Rose, 'complexity and dynamics, open rather than closed systems, are norms rather than exceptions [in the biological sciences], and the methodology of reductionism, however powerful, has difficulties in dealing with complexity.'[15] Cornwell considers reductionism inherently inadequate in dealing with living beings: 'Biology that emphasises the primacy of populations and whole organisms, as opposed to genes and molecules, is obliged to work not only bottom up, but top down. In other words, good biology involves a balance of reductionistic and holistic method.'[16]

Some Moral Implications

Whether science is morally neutral or value-laden is a matter of controversy, particularly in the context of recent developments in the philosophy of science. Even if science is shown to be theoretically value-free, the use of science can hardly be considered so, since how it is used and for what purpose will depend on one's value system and motives. This is particularly true of the biological sciences, because, as we have seen, these sciences involve the very being and intimate life of human persons themselves. This is even more serious in the case of the human genome since it refers to the most detailed and intimate aspects of humans. In this context I discuss a number of views that have gained currency in our times.

Reductive Materialism: According to reductive materialism, moral behaviour is like physical behaviour and moral laws are like physical laws. All features of human behaviour, including moral behaviour, can in principle be explained in terms of laws governing the behaviour of matter. For the adherents of this view the genome is welcome news since it appears to provide them with precise laws to explain human behaviour.

However, the history of science has exposed the poverty and inability of materialism to explain many important aspects of human experience. In the nineteenth

century, the mechanical philosophy of science made almost the same claims as reductive materialism. But it failed miserably. Human experience and behaviour seem to go beyond what can be captured by mere interaction between material particles, however sophisticated. In this context the remark of Francis Collins is pertinent: 'Behaviour patterns, while they may be genetically influenced in modest ways, are never going to be understood by fleshing out all the DNA sequence of the human genome, at least in large part.'[17] For instance, he thinks that 'we will not understand important things like "love" by knowing the DNA sequence of *Homo sapiens*.'[18]

Behavioural Genetics and Human Freedom: Many proponents of behavioural genetics believe that human behaviour is determined by the genes, and hence human freedom is illusory. In the context of the genome revolution the situation is even more serious. If life and behaviour are decisively determined by the ordering of the base pairs in the genome, one has no choice but to follow the set pattern, and so ceases to be free. Since one is not free, moral responsibility also fades away. Criminals could justify their actions by pleading that their genome structure made them commit the offence. Such a situation would render human and social life impossible.

However, both Collins and Venter disagree with the position of behaviour geneticists and affirm that the 'genomic information goes a long way in helping to show that we are not hard-wired'.[19]

Sociobiology: Certain developments in sociobiology are also quite pertinent in this connection since they also raise important moral issues. Sociobiologists like Michael Ruse believe that moral values are human constructs to meet a human goal, and attributes their source to the genes. He says: 'Darwinian theory shows that in fact morality is a function of (subjective) feelings, but it shows also that we have (and must have) the illusion of objectivity ... In a sense, therefore, morality is a collective illusion foisted upon us by our genes.'[20] Ian Barbour rightly points out that Ruse's claim is self-defeating, 'for once the secret is out that ethical norms are a collective illusion, we can hardly expect their social effectiveness to continue'.[21] There are other problems as well with this view. One could point out that moral principles are found in all societies at all times; some principles seem to be almost universally accepted. One would be hard pressed to relegate them to the realm of 'collective feelings' or 'collective illusion'.

Holmes Rolston disagrees with the claims of sociobiologists. According to him, 'transmission of cultural information occurs through language, tradition, education, and social institutions rather than through genes ... Cultural beliefs can override or offset the genetic tendencies inherited from our prehuman and Stone Age ancestors.'[22]

Genome as an Abettor of Discrimination

Racial, Caste Discrimination: Some ethicists fear the possible abuse of genomic knowledge, particularly in the hands of racists. Genomic information can help people to trace their family tree and identify more exactly the race or special groups they belong to. This can lead to narrow groupism and exclusivism. Dr Arthur Caplan, an ethicist at the University of Pennsylvania, airs this fear: 'Most geneticists wax

euphoric that so many of our genes are in common, that the genome map will show us to be a happy band of brothers and sisters. I doubt it.'[23] He foresees groups who will use this information 'to bolster racial and ethnic prejudices and other exclusivity groupings they believe in'.[24] One may remark that Dr Caplan is crying wolf, that people will be responsible in the use of the genomic data. He is not impressed by this answer. According to Caplan, 'the people involved in the mapping are medical people who don't spend much time thinking about the historical and social implications. So there will be lots of bombshells, some of them sadly revisiting some of the bigotry that has cycled around genetics for many years.'[25] In India, this may be used for perpetuating the caste system, and the discrimination associated with it.

Individual Discrimination: The information from the genome of a person can be used for personal discrimination as well. Indiscriminate use of the genomic information can lead to unjust and easy categorization of persons into disadvantaged categories. For instance, the genome may show tendencies to certain sickness, and that person may be banned by an insurance company or by an employment agency or prevented from getting married to a particular person. Or it may show some tendency to antisocial activities, and the victims treated as outlaws even before they commit any crime.

These forms of discrimination are based on the false premise that DNA can never change. However, Barbara McClintock of Cornell University has argued against this. According to her, DNA can undergo quite radical changes during the lifetime of an organism. For instance, sections of DNA can jump from one site to another in the genome, or more copies of a gene may be produced as a result of interactions with the environment.[26] This clearly shows that if the above-mentioned tendencies are genome-driven, they can undergo change. However, ethicists fear that our generation is too impatient to wait for these changes.

Widening the Gap between the Rich and the Poor: Whatever the benefits of the genome, one thing seems to be certain: most of the benefits from it will be beyond the reach of ordinary persons, at least in the near future. This is true in the case of genetic research in general, and genetic engineering in particular. Many of the special benefits claimed in the field involve complex genetic engineering. This means stretching one's pocketbook beyond the breaking point even in an affluent developed country. For most in the developing countries, these developments may not go beyond newspaper reports. This would mean that the rich in a country will have an almost exclusive right to better health, better looks, better educational and professional opportunities, longer life, and so on. This will automatically give a decisive advantage to the rich nations over the less rich ones.

One may reply that this widening will be a temporary initial phenomenon and, in the course of time, all these facilities will reach most people. However, this claim is highly complex and controversial. It seems to me that the more powerful the tool in the hands of the mighty, the greater the possibility of exploitation. Only by enacting strong and stringent laws to make the benefits of the genome revolution available to all, and by being zealously scrupulous about enforcing them can this threat of exploitation be countered. Collins also emphasizes this point: 'We have to pay just

as much attention to the ethical, legal, and social issues as we do to science. We need to provide protection against discriminatory uses of genetics ... If we are going to see that happen, we have to be sure that people are informed about what is going on.'[27]

Genome as an Aid to Settling Morally Significant Disputes: The genome revolution has some salutary consequences in the moral sphere as well. The power and accuracy of the genomic data can be used in giving an accurate and fair judgement on many intricate and delicate issues. For instance, it can be used to settle paternity and immigration suits. It can be a very reliable tool for identifying the actual culprit in a complex crime, so that the guilty will be punished and the innocent acquitted.

The Genome Revolution and Attitude towards Animals: One of the things genomic research has revealed is that the difference between humans and other animals is not drastic; in fact, it is only a matter of degree. We have seen that humans share 98.4 per cent of their genome with the chimpanzee, and a significant 75 per cent with the mouse. Similar comparisons can be made with other living beings. This calls for humans to have a more respectful attitude towards animals. The old injunction to 'have dominion over animals' will have to give way to 'have respect for animals'. This will also call for greater respect and appreciation for nature as a whole, since the whole of nature is closely linked.

Uniqueness of Humans: Traditionally religion has assigned a unique place to humans. Contemporary science also considers humans as unique in having certain special abilities like self-reflection, abstract thought, and so on. The human genome is the most complex and intricate. But its uniqueness is only relative. As has been mentioned above, genetically humans share much in common with animals and plants. In the words of Venter, humans 'are not important as a species because we have three billion letters. Corn has three billion letters. Some plants have tens of billions of letters of genetic code with far fewer genes than we have.'[28] He goes on to point out that the source of 'human complexity comes from the added levels of changing regulation of a finite number of genes.'[29] What the genome project has revealed is that, though quantitatively the difference is not so considerable, qualitatively it is, and it marks humans out as special. Most religions have absolutized the uniqueness of humans. The genome project and its findings seem to challenge this absolutization of humans. It seems to tell us that such an absolutization is unnecessary since the difference revealed by the genome is adequate to guarantee the legitimate superiority of humans and to accord them a special place in creation.

We have seen that the genome revolution extends new support to continuing evolution in the universe. In such a universe humans have a unique role to play, a role no other living being has. They are capable of guiding the evolutionary process. Genetic engineering buttressed by genome information puts tremendous power into the hands of humans to decide in what direction their development should take place. They are empowered to decide the destiny of creation, albeit in limited ways. They become in this way co-creators with God. Seen from this perspective, developments in genome research seem to enhance the dignity of humans.

The Genome Revolution and Religion

The recent surge of interest in genetics spurred by the announcement of the draft of the human genome has brought the science–religion debate to the fore. Claims made by the media and by certain scientists give the impression that the genome is well on the way to evicting God and religion from the face of the cosmos. 'The secret of life' has been revealed, 'the book of life' has been deciphered, 'humans now know what only God knew', and so on are just some examples of this ebullience. The implication seems to be that hitherto life was a mystery beyond human comprehension, but now that too has been brought under the purview of human knowledge. So now humans can declare their self-sufficiency and independence; God is superfluous.

But history seems to have proven false all these critics of theism and religion. According to a study conducted in 1997, '40% of the American scientists believe in a personal God – not merely an ineffable power and presence in the world, but a deity to whom they can pray.'[30] It is reported that more than 90 per cent of Americans believe in a personal God.[31] A paper in *Scientific American*, written in response to the *Newsweek* article, says that in America 'scientists' beliefs have changed little since the 1930s.'[32] Interest in the science–religion interface has seen an unprecedented surge in recent times. It is reported that the number of books in this area has 'tripled from 71 during the 1950s to 211 in the 1990s'.[33] It may be noted that Collins himself was an atheist in his younger days. He says that it was his scientific research and his deep personal reflection on it that brought him back to religion.

This does not mean that the developments in science have not affected religion in any way. They certainly have, and religion has undergone changes in many respects. Just as science has changed and grown over the years, certain aspects of religion too have evolved, thanks to external influences such as science and technology. But there is no reason to believe that religion is going away. Every new development in science seems to challenge religion to think anew some of its tenets and to come up with an appropriate response. The genome project is no exception.

Evolution, the Nature of God, and the Mode of Divine Action: There is considerable consensus in the scientific community that the genome revolution has added further and stronger evidence for the thesis of an evolutionary universe. If the evolutionary perspective is accepted, the traditional concept of God will have to be modified. Most religions still seem to be committed to a Platonic 'craftsman' type of God, who brings into existence beings as finished products. The doctrine of 'creation out of nothing' gets around some of the problems with the Platonic concept, but it too reflects belief in the creation of finished products. If the theory of evolution continues to get strong support from genome research, the challenge of evolving a new concept of God will be formidable. It goes without saying that this will call for a new way of understanding divine action. Many scientific-minded theologians and thinkers are already at work to meet these challenges. The tremendous success of the genome project and the incredible promise it holds out make it urgent for theologians and other thinkers to take an active and creative role in this revolution.

Genome and Evidence for God's Existence: The human genome, more than anything else, reveals the mastery and mystery of creation. It reveals the creator's control over creation while, at the same time, its complexity and intricacy remain a baffling mystery to us. The numbers involved are staggering. We have seen that in an average human body there are one hundred trillion cells. In the nucleus of each cell there is DNA which contains over thirty thousand genes. In each gene there are over one thousand nucleotides, each one of which has over fifty atoms. These trillions and trillions of atoms are arranged in the most orderly manner to make the complex life possible. This is for just one human being, and we have over six billion of them walking around on the planet. Can one say all this just happened? Even if it were reasonable to claim this, another question remains: Why did these atoms do so? The facts exposed by contemporary science render this question even more compelling. The response of Francis Collins, the man who knows the genome revolution best, was 'a sense of awe'.[34] As has been mentioned already, this reflection transformed him from an atheist in his younger days into a practising Christian at the prime of his scientific career. Instead of taking him away from the religious and spiritual side of life, the HGP has engendered in him a deeper awareness of it. He comments: 'I experience a sense of awe at the realization that humanity now knows something only God knew before. It is a deeply moving sensation that helps me appreciate the spiritual side of life.'[35] Far from weakening his religious belief, the genome project has only strengthened it. Collins is not the only scientist to have had this kind of experience. The well-known astronomer Allan Sandage had a similar experience through his work in contemporary astronomy. Speaking of his turnaround from 'almost a practising atheist as a boy' to a believer at 50, he says: 'It was my science that drove me to the conclusion that the world is much more complicated than can be explained by science. It is only through the supernatural that I can understand the mystery of existence.'[36] One can give many other similar cases. Decades ago both Albert Einstein and Werner Heisenberg echoed similar sentiments. The recent developments in genetics, particularly in genome research, need not lead to dispensing with God, but may invite us to learn more about the being who has made it all possible.

A Greater Role for Religion: It seems to me that the contemporary developments in science and technology, and particularly the genome project, far from diminishing the role of religion in our world are enhancing it. Science and technology reveal both the power and the limit of science – power, because it is able to unleash undreamed of physical and intellectual energy, limit because it is unable to handle the consequences of that energy. In fact, we are faced with a paradoxical situation: on the one hand, scientists are finding out more and more wonderful facts about nature; on the other hand, it seems that they are becoming less and less equipped, by training and temperament, to handle the problems associated with these facts. In the past most scientific problems were very much limited to the scientific field, and could be handled by the scientific community. These problems affected humans from the outside; they affected mostly how well humans lived. Today the problems go beyond the domain of strict science; their consequences affect humans from the inside, the very core of human life, the very essence of what a human person is. These

areas and these consequences are beyond the reach of pure, professional science. Other disciplines, particularly those that touch humans deeply and intimately, will have to team up with science to develop a comprehensive solution. Religious and moral principles will have to enter into a partnership with science to ensure that the precious treasures uncovered by science are put to the best use – for humanity and the rest of creation. It seems to me that the most recent scientific developments are not a move by a self-sufficient and self-conceited science to banish other disciplines, especially religion, but an invitation to them to enter into a healthy, responsible, and respectful partnership.

Notes

1 Reported in *The Indian Express,* 27 June, 2000.
2 Ibid., p. 32.
3 Ibid., p. 32.
4 See ibid., p. 33.
5 Julia Karow, 'The Other Genes', in *Scientific American*, July 2000, p. 43.
6 Quoted in Karow, p. 43.
7 Thomas Jay Oord, 'The World in a Grain of Sand: Genome Project center stage at AAAS', *Research News and Opportunities*, 1 (2001), p. 15.
8 Quoted in Oord, p. 1.
9 Oord, p. 15.
10 Susan Aldridge, *The Thread of Life* (Cambridge: Cambridge University Press, 1998), p. 35.
11 See Carol Ezzell, 'Beyond the Human Genome', *Scientific American*, July 2000, p. 54.
12 Nicholas Wade, 'Understanding the Book of Life', *Frontline*, 21 July 2000, p. 88.
13 Quoted in M. Kaku, *Visions* (Oxford: Oxford University Press, 1998), p. 143.
14 Ibid., p. 140.
15 Quoted in John Cornwell, 'Scientists Playing God', *The Tablet*, 8 July 2000, p. 920.
16 Ibid., p. 920.
17 Quoted in Kaku, p. 140.
18 Ibid., p. 140.
19 Quoted in Oord, p. 15.
20 Ibid., p. 124.
21 Ibid., p. 125.
22 Holmes Rolston, *Genes, Genesis, and God: Values and Their Origins in Natural and Human History* (Cambridge: Cambridge University Press, 1999), quoted in Ian Barbour, *When Science Meets Religion* (San Francisco: Harper Collins, 2000), pp. 125–6.

23 Quoted in Wade, p. 86.
24 Ibid., p. 86.
25 Ibid., p. 88.
26 See Aldridge, p. 72.
27 Quoted in Oord, p. 15.
28 Ibid. p. 15.
29 Ibid., p. 15.
30 Sharon Begley, 'Science Finds God', *Newsweek*, 27 July 1998, p. 48.
31 Ibid., p. 48.
32 'Scientists and Religion in America', *Scientific American*, September 1999, p. 78.
33 Barbour, p. 1.
34 Quoted in Cornwell, p. 920.
35 Ibid., p. 920.
36 Begley, p. 47.

Chapter 11

Partner of the Sciences or Object of Study? Theology and Religion in Relation to the Sciences

Willem B. Drees

The following is a programmatic essay on the agenda of 'religion-and-science'. It surveys a vast territory. It does not address particular issues in cosmology, physics or biology, but rather steps back from such particular discussions to consider problems and prospects of projects in religion-and-science. The first part of this paper is about three problems in religion-and-science, where this 'and' may be imagined as articulated in the form of 'natural theology' or a 'theology of nature'. It is suggested that problems arise due to assumptions:

- of symmetry,
- of explanatory plausibility, and
- of goodness ('consonance').

Such assumptions underlie many projects in 'religion-and-science' and 'natural theology'. It is argued that projects that are after 'consonance' or 'harmony' and treat religious views as comparable in kind to scientific explanations fall short of their ambitions, both for epistemic reasons and for moral reasons, that is, for failing to take science and evil sufficiently into account.

In the second half, I offer my proposal for what I consider to be reasonable and meaningful ambitions of 'religion-and-science' by considering three expressions, namely:

- the acknowledgment of 'dissonance' as an incentive for methodological and moral constructive work, as a way of avoiding problematic assumptions about goodness;
- the ontological one of 'religious naturalism', correlating with problems considered under 'explanatory plausibility'; and
- an understanding of theologies as particular proposals regarding the way a cosmology and an axiology are held together, whether in harmony or in tension, which would allow one to envisage meaningful relationships without assuming symmetry.

The Problem of Symmetry: Building a Bridge?

Some in religion-and-science see their ambition as building a bridge between theology and science.[1] Such a model is symmetrical; theology and science each have their own side of the river – like two distinct and autonomous kingdoms, the task being to connect the two sides by building a bridge with foundations on banks on both sides of the water.

However, the intellectual standing of both human endeavours is quite dissimilar. The natural sciences have expanded the domain covered from human size ranges to minute details within atoms as well as to galaxies and even larger structures. They have shown an impressive increase in coherence across disciplines, as witnessed by the emergence of disciplines such as molecular biology. They have shown an enormous trend towards unification in ideas and explanatory schemes with respect to fundamental theories in physics as well as in the life sciences. They have proven to be eminently applicable, delivering us the power to manipulate individual atoms and genes. In contrast, neither at the level of ideas nor at the level of practices is there a similar record of specific convergence and fruitfulness for the religious traditions.

The success of the sciences has been paid for, to some extent, by modesty in ambitions. In the present context, two kinds of modesty are especially important to consider. The sciences have sought to abstain from moral and other evaluative judgments regarding reality. And they have focused on aspects of reality that were open to effective treatment, with operational definitions of concepts such as 'energy' or 'life', while abstaining from metaphysical, essentialist questions about such notions. In contrast, religious thinkers of various kinds have sought to articulate ideas about ultimate reality and the inner essence of things, transcendent explanations and the like, as well as concerning the meaningfulness of life or absolute values. (Not that all scientists or all religious thinkers have kept to their side of this divide, but still, the difference in role indicated here is more or less a mainstream understanding of science and of religion.) Thus, both by scope (science being more limited in the kind of activities allowed) and by success (science being more successful), the enterprises of science and of religion are quite different. To this can be added differences in function (explanatory?) and differences in relation to reality and evil, to which we will return below.

Another disadvantage of the 'bridge model' is that it treats the banks as given; the project is the building of the bridge. However, in doing religion-and-science we are engaged in disputes over the nature of religious convictions and practices. Thus, rather than assuming symmetry, to me it seems more useful to acknowledge the asymmetry of religion and science in the intellectual pursuit of thinking through their relationship.

Unlike those who seek to develop a 'theology of nature' as a project that assumes a strong basis in a pre-given theological view, I am with 'natural theologies' in accepting asymmetry in the argumentative pattern, which runs from science to theology or metaphysics. However, if 'natural theology' serves as apologetics for a fairly traditional theological position, it is more indebted to the assumption of symmetry than seems reasonable to me. But that brings me to the second contention regarding problems: Will such arguments deliver what is desired? And is it desirable

to treat science and religion as explanatory projects, either conflicting with or complementing each other?

The Problem of Explanatory Plausibility

In 'natural theology', the argument is in general from science to theology; theology is expected to provide an additional explanation where science leaves off. However, such projects run into various problems.

The metaphysical aspect of religious convictions may seem to be supported or challenged by developments in theoretical physics and modern cosmology, which seems to deal with 'ultimate questions' about the nature and origin of reality. However, in many cases, 'proofs' – in favour of or against theistic ideas – rest upon assumptions and concepts which turn out to be quite problematical, often highly dependent upon a particular tradition, or upon moving beyond the domain of validity of certain concepts of theories.

Two examples might be offered. The Kalam-type cosmological argument advanced by William L. Craig neglects the possibility of further developments in a theory of the universe which combines quantum physics and gravitational theories of space and time, which may not only extend our idea of time past, but may also modify our understanding of the concept 'time'. Richard Swinburne's argument based on the preference for the simplicity of one Creator over many universes is threatened to fail due to abuse of the notion of simplicity, focusing on entities rather than on assumptions involved in a particular theoretical scheme.[2]

More generally, we need to consider the reliability of scientific theories. All theories are human constructs. However, some seem so well rooted in our technological practices and our effective understanding that it is extremely hard to imagine that they will ever be abandoned. A prime example is the knowledge expressed in the periodic table, found in any classroom in chemistry. This seems to be knowledge as solid as one may ever expect to have – unlike, to mention an alternative, ideas regarding superstrings. Knowledge about that which is not the case most often is 'solid' (or perhaps the more appropriate term would be 'consolidated'); a 'flat Earth', for example, is really ruled out. Evolution, both as the gross understanding of natural history and as a Darwinian explanatory scheme, seems to me to fall into the same category of 'solid knowledge'. Such well-established knowledge offers *constraints* on religious positions. Positions that are at odds with solid knowledge, such as homeopathy and anthroposophy (with respect to chemistry) and various kinds of 'creationism' (with respect to evolution), thereby significantly lack credibility.

Sometimes arguments are based on claims about that which science is unable to explain. However, such claims need very careful scrutiny. To some extent, the sciences have made clear why we are unable to observe or calculate certain aspects of reality; in those cases, the phenomenon in question does not reveal gaps in the scientific understanding but rather exemplifies its power. Building upon limitations of the sciences within their domain underestimates the power of the sciences. God-of-the-gaps-type arguments in natural theology (for example with respect to design) may have been useful as apologetics for science in a religiously oriented (sub)culture,

but they do not do justice to the sciences. It is more appropriate to appreciate the great gift of understanding, rather than to seek again and again shelter in self-inflicted immaturity.

In natural theology the ambition is mostly to be in line with current knowledge, and to use knowledge (rather than lack of knowledge) as a basis for establishing conclusions. Whereas a conflict with solid knowledge effectively rules out a particular conviction, this is, trivially, not the issue when we use current knowledge. However, it is important to note that in many of the issues considered in 'natural theology,' such as the nature of time and space, of causality and lawfulness, and so on, we deal with speculative ideas in science, not yet integrated extensively into our web of knowledge and practice, and thus quite different in standing from the periodic table and other consolidated knowledge. There continues to be room for pluralism within the sciences, for example with respect to the fundamental nature of time or substance. In that sense, the sciences *underdetermine* metaphysical speculations (while the scientific theories are themselves underdetermined by data). Thus, one may articulate limit questions in relation to current scientific understanding, and can make perhaps a convincing case for the persistence of limit questions even if the sciences were to achieve a 'complete theory'; the sciences do not force a single 'best answer' upon us. Theism, atheism, pantheism are all defensible interpretations in contemporary cosmology, as are convictions regarding the temporal or timeless character of ultimate reality. With respect to such issues, the sciences rule out some ideas, but lead to an agnostic attitude with respect to positive claims.

Let me offer one additional comment on religions and natural theology. Natural theology is focused on ideas, and thus lives in the domain of arguments and explanations. However, religions are also human practices. This is not an accidental feature of them, but a major explanation and justification for their persistence. When this dimension of religions is lost or out of sight, we risk serious misunderstanding. As human practices, religions are phenomena in the world, and thus objects of study, rather than, as in natural theology, a partner of the sciences and philosophy in understanding and explaining our world.

The Problem of Consonance: Our World the Best of all Possible Worlds?

Last but not least, a third area of problems for natural theology and theologies of nature goes well beyond the intellectual problems indicated above. It is theologically problematic to assume 'harmony' or 'consonance' between scientific knowledge and religious convictions, at least on certain theological views.

The term 'consonance' was used in passing by Ernan McMullin in 1981 in reflecting on the relation between the Big Bang theory and the Christian idea of *creatio ex nihilo*, or more general, on a position intermediate between a positivist dismissal of cognitive claims in theology and the construal of a Biblical world-view:

> The Christian cannot separate his science from his theology as though they were incapable of interrelation. On the other hand, he has learned to distrust the simpler pathways from one to the other. He has to aim at some sort of coherence of world-view, a coherence to which science and theology, and indeed many other sorts of human construction like

> history, politics, and literature, must contribute. He may, indeed, *must* strive to make his theology and his cosmology consonant in the contribution they make to this world-view. But this consonance (as history shows) is a tentative relation, constantly under scrutiny, in constant slight shift.[3]

Whereas McMullin introduced the musical metaphor of 'consonance' mainly as a critical epistemic notion, *against* having too much confidence in the contribution theology could make to the appraisal of scientific theories, the term has acquired an affirmative meaning in the writings of others. 'Consonance' has become a flag in religion-and-science, especially for some who claim that there are two independent sources of insight, which happen to be in harmony. Ted Peters, a Lutheran theologian associated with the Center for Theology and the Natural Sciences in Berkeley, titled a book he edited *Cosmos as Creation: Theology and Science in Consonance* (1989); another book he edited was entitled *Science and Theology: The New Consonance* (1998). Peters speaks of 'hypothetical consonance' on 'the domain of inquiry shared by science and theology'. Hypothetical, as:

> It would be too much to say that the current state of the dialogue between science and theology consists of total accord or total agreement regarding the role that God plays as the world's creator and redeemer. … In its milder form consonance functions as an hypothesis: If there is only one reality and if both science and theology speak about the same reality, is it reasonable to expect that sooner or later shared understandings will develop?[4]

In my opinion, the term 'consonance' as it has come to be used by others since the initial usage by McMullin has various disadvantages. It assumes theology as a source of knowledge on equal footing with the sciences, as discussed already above (see above, the comments on asymmetry). But the more important problem is in the assumption that we are looking for *harmony* between theological and scientific ideas. Many theologies embody a critical attitude towards reality – introducing a dualism of the real and the ideal, of the way things are and the way they should be, a contrast between the present and the Kingdom, and so on. Arguing for 'consonance' risks becoming an argument that this is the best of all possible worlds, that evil is not genuine but only apparent, or justifiable, and so on. Such forms of harmony have been questioned again and again in the history of Christian and Western thought; just to refer to a few thinkers that come to mind: Marcion in the second century, Voltaire (for example, *Candide, ou l'optimisme* [1759]), and some of the dialogues in F. Dostoyevski's novel *The Brothers Karamzov*. Thomas H. Huxley (in his lecture 'Evolution and Ethics' of 1893) and, in our day, G.C. Williams, have argued against the design tradition that God as seen in relation to natural reality is neither smart nor good. The ambivalence of reality challenges a straightforward alignment of science and religion.[5]

For a 'mystical' theology ('religion mystical'), which reflects a desire for divine presence in continuity with our lives and our knowledge, awareness of the limitations of our models may be sufficient with respect to the otherness of the divine. However, such a distinction between our models of the divine and the divine reality itself is not enough for a 'prophetic' theology ('religion prophetic'), which is characterized

by a sense of difference and contrast, of divine absence rather than presence, of contrast between what is and what should have been. On a prophetic understanding of theology, there is a sense of 'and it is not', for which there is no analogy in science. In a prophetic theology, people seek to articulate a sense of contrast between God and the world, between how humans behave and how God intended them to behave (for example, Isaiah (55:8), or, in less theistic terms, between ideas about 'what ought to be' and 'what is'. An 'is not' as a form of modesty about our language and knowledge is not enough to articulate such a sense of contrast.

Natural theology has been too much about that which 'is', lacking more critical dimensions. It has often been too selective, focussing on the nice features of reality, but not addressing the darker sides of nature – the bird praises his maker, but what about the worms?

Having described briefly three clusters of problems, I will now move on to a more constructive project, articulating how I envisage meaningful interactions between religion and science. In reverse order, relative to the preceding discussion of problems, I will speak of 'constructive consonance', 'religious naturalism and limit questions' and an understanding of theology as 'cosmology-and-axiology'.

Creative Dissonance

Above, I have been critical of overly optimistic expectations regarding 'consonance' for two reasons. One reason has been methodological: we do not *find* consonance between scientific knowledge and already given theological ideas, but rather *reconstruct* our ideas so as to make them as coherent as possible. The other concern is not methodological but moral or praxiological: assuming consonance between our reality and theological ideas regarding a good God runs the risk of denying too much the ambivalence of our reality.

The dissonance discerned, morally and methodologically, may be an incentive for considering religion-and-science as a constructive project.[6] 'Constructive' may be understood in the intellectual sense, as any consonance we uncover is a human construction. It may also be understood morally, as religious traditions are not only about that which is but also about 'that which ought to be but is not' – a recognition of disharmony which calls for action and has critical consequences for any easy claims about consonance between scientific insights and religious language. Thus, acknowledging 'creative dissonance' calls our attention to constructive human action, and thus to human creativity as manifest in culture, art, and technology. Let me consider both aspects in turn: the constructive character of our understanding (images) and the constructive character of our world (technology).

Creative dissonance and the construction of images

'Creative dissonance' and its constructive implications can be appreciated as a methodological view. This is not meant as referring to method in a technical sense, about how to develop Bayesian arguments or how to do double-blind experiments. It rather is an understanding of human existence, seeing human identity as unfinished,

and humans as culture-creating animals. The project is, one might say, poetical, in the double meaning of poetry and of *poiesis*, of making things – and even of changing ourselves, reaching into our own depths, and the complexities of cultures and persons.

What would be the best way to proceed with images and concepts offered by religious traditions as part of our heritage? The development of physics offers a helpful analogy. When we consider major transitions, such as those from Newtonian conceptions of space and time to Einsteinian views, or from classical to quantum conceptions of matter, we may be struck by the lack of continuity at the level of ontology, of conceptualization of reality. However, there is in these cases also continuity at less abstract levels of knowing, for instance with respect to predictions concerning the orbits of planets. The way from the older to the newer view is not via a translation at the level of theories, but rather one of developing new theories that do better justice to experiences and experiments coded to a large extent also in the old theories.

Similarly in religion. We need not aim at continuity at an abstract level, one or more interpretative steps away from actual life. Continuity with the insights of earlier humans, including those found in the Bible and the writings of the early churches, should be sought at the level of life as lived. The more abstract levels, including notions such as the Trinity, the virgin birth, heaven, and even God, are constructions, and these constructions or interpretations may change drastically even though one seeks to be fair to the underlying experiences. Fundamentalists and those who reject Christianity because they think it has to be fundamentalist, often make the error of conflating different levels. They take the original form of expression of human concerns and experiences to be as important as those experiences and concerns themselves. One may attempt to develop new world views in which everything of old has an equivalent, ending in complete failure since the new images do not relate sufficiently to the experiences that led to their predecessors. A typical area is eschatology, where images of 'another place', 'a future perfection', and 'personal life beyond death' may be updated in such a way that major underlying concerns, such as anger about injustice, are lost.

Thus, the best way to renew religious language and models is to think about the manifest images as they functioned for humans in earlier periods, and to find out as far as possible what the underlying concerns and experiences were. In as far as we recognize those experiences and concerns and see them as our own, we can attempt to develop new images and models, new ways of dealing with them in images which are credible in our time, in the context of all else that we take serious, including science.

This is unlike realism in the sense that it does not seek to protect (by reinterpretation or otherwise) the truth-claims of religious metaphors and models of an earlier age – because these metaphors and models are not so much understood as truth-claims but as language which helped individuals to live their lives and communities by creating and maintaining a culture. Realists are, in general, less interested in the detour via the analysis of the human concerns and experiences that lie behind the images; they focus on the truth-claims which appear to be articulated in metaphors and models, whereas I think that we should pay attention primarily to the relevance these images had in the context in which they had a place.

Technology: Constructing realities

Science offers more than understanding; it provides us with the tools to change our world. Chemistry not only seeks to understand nature, but to make things not present before – the artificial. Historically speaking, the interactions between theology and disciplines such as physics and biology have been quite different from the interactions between theology and chemistry. There are many 'natural theologies' based on insights from biology, physics, and astronomy. These sciences, at least initially, were more focused on describing and understanding reality than on modifying it. Such a view of science fits well with the idea that there is a given order, and a Giver of the laws who has generated this order. Chemistry is, however, absent from the natural theologies of the seventeenth, eighteenth and nineteenth centuries, as the historians of science John Brooke and Geoffrey Cantor observed in the final chapter of their *Reconstructing Nature* (1998). In our days, almost all the sciences have such an active, creative side. Think of the creation of new materials with a wide variety of properties, of electronics that give rise to information and communication technologies, and of biotechnologies of various kinds, with major consequences for food production and medicine.

An active attitude is deeply rooted in human nature; we are as much *homo faber* as we are *homo sapiens.* I doubt whether a moral person could desire that we could do without this active side. There is, of course, the mythical image of paradise, of an effortless pastoral life with fruit in abundance. But if we are more realistic, we realize that we need our technology – and we need it also for morally lofty purposes, to feed the hungry, to clothe the naked, and to care for the sick.

Interest in the artificial fits ill with the European, and especially the British, tradition of natural theology, of arguing from nature to its Author. Brooke and Cantor quote the political radical Richard Carlile who wrote in 1829: 'With the doctrine of an intelligent deity it is presumption to attempt anything toward human improvement. Without the doctrine, it is not any presumption.' Brooke and Cantor add: 'It is as if arguments for divine wisdom require this to be the best of all possible worlds, with the corollary that attempts at improvement would both be sacrilegious and ineffective.'[7]

The interest in chemistry aligns with a different theological emphasis, less in the legal and regal imagery of laws and wisdom or the mechanical imagery of cathedrals and clocks, and more immanent and spiritualist, as argued convincingly by Eugene Klaaren in his *Religious Origins of Modern Science* (1977)[8]. In chemistry, one finds the theme of purification, in both the material and spiritual sense. Furthermore, Brooke and Cantor observe that the emphasis on chemistry correlated often with 'a kind of process theology',' not in the technical sense of today, but as a view that saw in the world a collaboration, a co-creation, of humans with God. In speaking of *co-creation* one distances oneself from the idea that creation is in principle finished and complete – that God bypasses humans in arranging everything. The history of humanity is a history in which God works and humans have responsibility.

Stewardship has become prominent in reflection upon the ecological damage that we have done. Today, stewardship has the connotation of nature conservation. It fits better with reticence than with actively changing nature. But human activity is not

only a threat to God's good creation. It has also been seen as taking up the task God entrusted to us to work for the good. Strong words have been used by Isabel Carter Heyward in her book *The Redemption of God*. God is not so much the one who redeems us, as the one who needs to be redeemed. As for Ivan Karamazov, for her it is the suffering of the children that makes any theodicy futile, an attempt to justify God in the presence of burning children. We cannot shift the burden of responsibility to God; we are responsible. Our task becomes to make God present in the world, or, as she says in her original terminology, our task is 'to god the world'. The issue is that, in such theological projects, we are not doing theology primarily on the basis of positive experiences of beauty and goodness, but rather out of engagement with justice, with love. This makes one focus on *transformation* as a central theological theme.[9]

The Prospect of Religious Naturalisms

When we want to use religious language in a way that has some plausibility, we cannot bypass what we have learned in the natural sciences. With respect to *ontology*, we have come to conclude that all objects, including ourselves, consist of the stuff described by chemists in the periodic table of the elements. Physicists understand this stuff as consisting of elementary particles and forces, and that in turn is assumed to consist of quantum fields, superstrings, or whatever. As the 'whatever' indicates, such a naturalist must grant that our knowledge has not reached rock bottom yet – we cannot articulate our view from a fundamental ontology upwards. Nor does it imply that all phenomena can be described adequately in terms of physics and chemistry. With respect to *history*, we have come to understand living beings – again, including ourselves – as the current stage in a bundle of Darwinian evolutionary histories on our planet, which itself is understood as a transient phenomenon in a universe that has been expanding for some fifteen billion years. These insights do not commit one to a particular view about origins. With history as with ontology, the most fundamental issues about the beginning of our universe and the nature of time, space, and substance are not settled. The view indicated in this paragraph may be labelled 'naturalism'.

Among the social phenomena that have emerged in natural and cultural history are religious habits and traditions. Cultural anthropologists, historians and the like can study them. The processes of emergence, development, change, continuation and extinction of various religions are comparable to some extent to the emergence, change and disappearance of languages and legal systems.

All traditions are potentially rich resources of implicit wisdom. They have emerged and have been passed on for generations, and hence must have qualities that have stood the test of time. This does not guarantee that they are adequate in present circumstances, but still they all have some prima facie claim to being wisdom for us. In this context, biology is a better analogy than physics and chemistry. Diversity has arisen in and through a long historical process, with its contingencies. Biodiversity is to be valued. The explanatory tools are, at the level of the general theory, limited. If one knew evolutionary theory and the state of the planet Earth one billion

years ago, one could still not predict the variety of life forms that was to emerge. Nonetheless, there is no reason to assume that any of the life-forms which have emerged has not emerged through those evolutionary processes. Not only would one not be able to predict the actual variety, but one would often also be in trouble trying to understand all features of any living organism as adaptive (or as adaptive in relevant past environments, or as the by-product of some adaptive trait, and so on); certain major characteristics are easy to make intelligible, but there is more detail than we are able to explain explicitly. There is implicit wisdom in organisms, which prima facie deserves to be taken to be credible as wisdom appropriate for the circumstances.

The variety of religious traditions, with their narratives and symbols, their rituals and exhortations, is also impressive. Here, too, there is much that can be readily understood as having served biological or social functions in the past. But here, too, there may be more in the tradition than can be made explicit. The same argument applies to human nature and to human upbringing: there is more going on within us than we can make explicit or manage intentionally. If we tried to replace by univocal statements all the communication and teaching that takes place through stories, poetry, gestures and songs, much would be lost. Given the non-transparent nature of human nature, religious narratives may be considered valuable communicators of wisdom.

Explanations within a scientific framework do not explain the framework itself. Scientists always answer certain questions, while relegating other questions to, and borrowing assumptions from, other disciplines. In that sense, fundamental physics and cosmology form a boundary of the natural sciences, where speculative questions with respect to a naturalist view of our world come most explicitly to the forefront. Questions which arise at the speculative boundary one might call *limit questions*. The questions left at the metaphorical 'last desk' are questions about the world as a whole, its existence and structure, and not just questions about its beginning.

Some scientists suggest that science might in the end explain everything without leaving any limit questions. For instance, Peter Atkins argues that science traces complex structures back to more simple predecessors – elephants arise, given time and molecules; molecules arise given time and the right elements. The last stage of this 'tracing back' is the explanation of space and time themselves; they arise by chance out of nothing, an ultimate simplicity, which needs no further explanation. However, upon a closer look, this nothing is perhaps 'no thing', but not nothing – it has properties (a measure upon which 'chance' operates) and it is an existent, not merely an idea. Whatever fundamental theory one argues for, the question remains as to what 'breathes fire into the equations',' that is, what gives reality to some mathematical structure. The Hawking–Hartle model, which is one of the first major quantum cosmological models, does not lead to the probability 'for the Universe to appear from Nothing', as the authors claimed. Major assumptions are hidden in normalization and one also needs to assume quantum fields and the validity of mathematics for the scheme to work. More recently, Lee Smolin has suggested that the persistence of limit questions (and hence the association between fundamental physics and a theistic metaphysics) is a consequence of the emphasis on principles, and hence of the reductionist and atomist thinking that pervades physics. He has

suggested that this should be replaced by a more historical thinking, modelled after evolutionary thought in biology, in which the fundamental properties of our reality are the contingent products of history, or rather of the statistics of black-hole-producing universes. Though this is an interesting turn in the reflection on the nature of physics, it does not deliver one fully from limit questions. There are still the questions of why there is a reality and why it behaves in this way, with variations from one universe to another one.[10]

Limit questions are persistent, even though the development of science may change the shape of the particular ultimate questions considered at any time. The coherence of explanations of phenomena *within* reality is not itself an explanation *of* reality; explanations within the framework are not explanations of the framework. The integrity of reality does not imply its self-sufficiency, as the atheistic interpretation by Peter Atkins seems to assume. In that sense, a science-inspired naturalism is an incomplete position. Naturalism does not imply the dismissal of limit questions as meaningless, nor does it imply one particular answer to limit questions.

Religious interpretations

Scientific explanations only deal with explanations *within* the framework of reality. Thus, in relation to ultimate questions as they arise in the light of cosmology one can propose the view that there is a ground *of* reality which is the explanation of natural reality. In such a way, one can combine a naturalist view of reality with a *theistic dualism*, understanding the *natural world as a whole* as creation, dependent upon a transcendent Creator. Such a view might be articulated with the help of a distinction between primary and secondary causality, or between temporal processes in the world and timeless dependence of the world (including its temporal extension) on God. Such a view takes from the monotheistic traditions the distinction between God and everything that is not-God. However, this view is not dependent upon a dualist anthropology (that is, of body-soul). Nor need it be supernaturalistic, allowing for divine intervention in the web of natural processes, nor imply a 'divine command' theory in morality – as we are considering religious interpretations, arguing bottom-up rather than top-down. But it is theistic in that it emphasizes God's otherness.

The ontological dualism characteristic of the theistic position is unattractive to many naturalists who see it as too close to a natural/supernatural distinction, with the supernatural interfering in and upsetting the integrity of the natural. Such naturalists might be attracted to a *pantheist* view, in which an ontological duality of the natural and the divine is denied; the natural is in some sense the divine. Different aspects of our knowledge of the natural order may be taken as clues for such a view. Traditional attributes of the divine, such as a-temporality and omnipresence can be associated with the laws of nature, which on this view are not so much rooted in a transcendent source as immanent in natural reality. Reality may be seen as *causa sui*, in that quantum theories may allow a temporal universe to emerge, and on a smaller scale self-organization is characteristic of many processes. However, pantheistic answers invoke further questions and objections, just as the theistic answer always allows for the further question as to why such a god would exist. A particular question for

a pantheist view is why one would ascribe divinity to the whole or to all things. Are they all to be valued as good or beautiful in a way befitting the divine? Or is the understanding of the divine more ambiguous, matching the moral and aesthetic ambivalence of the world as secularly experienced? How are we to connect the cosmological and the axiological?

There is a third position possible as well, and that is a more agnostic stance. In his *Cosmic Understanding*, Milton Munitz argues that any actual theory of the universe is conceptually bounded; there might be a dimension of reality 'beyond' any such account, but which could not be expressed adequately in language. 'We shall be driven, consequently, and at the end, to silence, although the "talk" on the way, if at all helpful, will have had its value in making the silence a pregnant one, and indeed an occasion for having an overridingly important type of human experience.'[11] The theologian Gordon Kaufman points out, in his *In Face of Mystery*, various problems with the dualistic language of theism, as if we on this side of the great divide can know or speak well of that which is on the other side; such a way of speaking:

> is fundamentally incoherent, leading us to suppose we know something(s) which we cannot possibly know ... In all of this, of course, it is important that we keep in view the fact that our 'knowledge' of this world in which we live, and all the realities within it, always shades off into ultimate mystery, into an ultimate unknowing. In developing the concept of mystery in the way I do, I am seeking to retain what is valid in dualistic ways of thinking, without falling into their fallacies.[12]

Emphasizing 'mystery', not-knowing is a fairly safe strategy. However, the price is that it does not offer much guidance as to particular choices to be made in life; the notion of 'mystery' is more epistemic than axiological or ontological.

These three different views, the theist, the pantheist and the mysterianist, only briefly and inadequately described here, all have versions compatible with contemporary science and a naturalist understanding of it. The way they are articulated and defended may be influenced by current scientific theories (as these affect notions of time, space, causality, and so on), but variants of these positions can be formulated again and again. A religious naturalist can appreciate the human significance of religious traditions and the possibility of metaphysical explorations – even though the two are independent of each other, rather than as closely intertwined as they are in natural theologies or theologies of nature.

The Prospect of Asymmetry: Theology as Cosmology-and-Axiology

A third issue, apart from the ontological issues of the preceding section and the methodological and praxiological concerns related to 'creative dissonance', regards the understanding of theology. It seems to be typical of theologies, as systematic positions, that they offer a particular view of the way the world is *and* of the way the world should be, of the True and the Good, of the real and the ideal. Each theology is a particular mix of a relationship between a cosmology – in the metaphysical sense of being a view of the way the world is – and an axiology, a view of the values that should

be realized. Thus, as a heuristic to clarify and explore a complex area of discussion, I suggest a 'formula' for understanding the nature of theologies (plural) as:

a theology = a cosmology + axiology

with the + sign not being a mere addition, and with the crucial issue: how the two are brought together.

Though there are some superficial resemblances with a scheme proposed by Nancey Murphy and George Ellis in their book *On the Moral Nature of the Universe*[13], there are major differences. My scheme is a heuristic for exploring the field rather than a substantial thesis about the (singular) proper view of the relationship between theology, ethics and the sciences, as it is for Murphy and Ellis. Besides, I do not want to pronounce in this context on 'the moral nature of the universe'; my formula can also be used to describe positions of those who consider the universe to be amoral, whether indifferent or evil (for example, T.H. Huxley and G.C. Williams). Unlike Murphy and Ellis, for whom each level of understanding requires a higher one until it finally includes a doctrine of God, I do not consider an atheist to be necessarily deficient in understanding; he or she, rather, holds a different existential position.

Theologies can be quite different in the way they relate the cosmological and the axiological aspects. Let me indicate very briefly a few examples. Sociobiology can become a scientistic 'theology' when it pronounces on the basis of its cosmology on the values we are supposed to adhere to. Such a 'theology' would be fully dominated by one pole. Within the Christian tradition, there are – on my account – various theologies. When the emphasis is on God's saving activity, the tension between the way the world is and the way it will be is prominent, whereas in creation-oriented views (whether ecologically inspired or as natural theologies) cosmology and axiology stand less in contrast; the prophet emphasizes the tension, whereas the mystic stresses the way we belong to reality. Whiteheadian process thought is one particular articulation of the interplay of axiological and causal elements. This way of integrating regulative ideals into cosmology has required particular – and, in my opinion, problematic – choices in cosmology; choices regarding pan-experientialism and regarding the place of physics in the order of the sciences. However, it is an interesting and relevant effort to integrate valuational and causal elements in a single categorial scheme.

The attempt to combine 'is' and 'ought' statements is what makes theology problematic *and* valuable. The difficulty finds expression, again and again, in the problem of evil, which typically concerns the relationship or tension between the two main components. This tension is also present in 'religious naturalism', both when it comes to the introduction of normative elements in a naturalistic understanding, and also when we consider the variety of positions adopted. Whereas some understand God primarily in ontological terms – for instance, as the most powerful reality upon which we are dependent, with all the moral ambivalence that is thereby imported into the concept of God (for example, Ralph Burhoe) – others use the concept of God in a primarily valuational way, as a label for elements in reality deemed sacred (for example, Hardwick, Stone), concentrating on that which is ultimately significant, on

regulative ideals, and the like; they have to face the challenge of articulating how this can be considered real and effective.[14]

The definition of theology as 'cosmology-and-axiology' allows one to respect the autonomy of science and also of moral discourse. One can further differentiate between science and any interpretation of science as a view of reality, that is, any cosmology, metaphysics or philosophy of nature. A cosmology, in this sense, is a view of what the world (with its substances and relations, and conceptions of space, time, matter, forces, causality, and so on) might be like, given what we know (and what we know not to be the case; science may well be stronger in what it excludes than in what it includes). Any such metaphysics is an interpretation of scientific knowledge, constrained but underdetermined by the sciences.

As far as theology is concerned, the definition allows one to concentrate on *existential* issues which become prominent when our reality is not in accord with what we think it ought to be (the 'and' in the formula), rather than on *supernatural* or *magical* elements. Religion need not be about that which upsets the cosmological order, but rather about the way the axiological and the cosmological are related, in harmony or in tension. This also means that a religious naturalistic theology need not be conservative and defensive; it can well allow for the longing for redemption, for improving reality – an attitude in which we envisage the sciences as involved not only in understanding our reality but also in transforming it.

Conclusion: Towards an Anti-Natural Naturalist Theology

We have not gone much beyond Thomas Huxley's remark that ethical nature, though emerging out of biological nature, goes beyond or even against it. In that sense, the programme outlined above may be understood as:

> (a) naturalistic, in the sense that human existence, including human cultures, moralities and religions, are seen as the fruit of, or even as part of, nature, while at the same time seeking to articulate
>
> (b) 'anti-naturalist' attitudes, in the sense that humans are able to go beyond and against that which has been handed down by nature to us.

It is arguable that this combination is theologically more adequate, by integrating elements of 'creation' and 'redemption' into one larger project, than most natural theologies, which limit their attention to issues of 'creation', while disregarding the ambivalence of reality, and thus the longing for transformation that is so important to the religious quest.

Notes

1 The website of the Berkeley-based Center for Theology and the Natural Sciences, www.ctns.org, displays a magnificent picture of the Golden Gate Bridge and offers a rich essay on the study of theology and science, by its

founding director Robert J. Russell, which draws upon this imagery of 'building a bridge'.

2 W.L. Craig, *The Kalam Cosmological Argument* (London: Macmillan, 1979); R. Swinburne, *The Existence of God* (Oxford: Oxford University Press, 1979); objections have been articulated, a.o., in W.B. Drees, *Beyond the Big Bang: Quantum Cosmologies and God* (La Salle: Open Court, 1990), pp. 29–33.

3 E. McMullin, 'How should Cosmology Relate to Theology?,' in A.R. Peacocke (ed.), *The Sciences and Theology in the Twentieth Century* (Stocksfield: Oriel Press, and Notre Dame: University of Notre Dame Press, 1981).

4 Both citations are from page 1 of T. Peters (ed.), *Science and Theology: The New Consonance* (Boulder: Westview Press, 1998); the earlier book referred to is *Cosmos as Creation: Theology and Science in Consonance*, T. Peters (ed.) (Nashville: Abingdon Press 1989).

5 T.H. Huxley, *Evolution and Ethics* (London: Macmillan, 1989); reprinted in *T.H. Huxley's* Evolution and Ethics*, With New Essays on Its Victorian and Sociobiological Context,* J. Paradis, G.C. Williams (eds) (Princeton: Princeton University Press, 1989). See, in this same volume, G.C. Williams, 'A Sociobiological Expansion of *Evolution and Ethics*' and, elsewhere: G.C. Williams, '*Gaia*, Nature Worship and Biocentric Fallacies', *The Quarterly Review of Biology*, 67 (4 December 1992): 479–86.

6 In the past, I introduced the notion of 'constructive consonance' (W.B. Drees, *Beyond the Big Bang*). However, a remark by G. Cantor following a presentation of these ideas in Leeds induced me to prefer the expression 'creative dissonance'.

7 J.H. Brooke, G. Cantor, *Reconstructing Nature: The Engagement of Science and Religion* (Edinburgh: T&T Clark, 1998), p. 314.

8 Eugene M. Klaaren, *Religious Origins of Modern Science: Belief in Creation in Seventeenth-Century Thought* (Grand Rapids: Eerdmans, 1977).

9 Isabel Carter Heyward, *The Redemption of God* (Lanham, MD: University Press of America, 1982).

10 P.W. Atkins, *The Creation* (Oxford: Freeman, 1981); J.B. Hartle, S.W. Hawking, 'Wave Function of the Universe', *Physical Review* D 28 (1983): 2960–2975; on assumptions hidden in their work, see Drees, *Beyond the Big Bang*, pp. 71–3 and L. Smolin, *The Life of the Cosmos* (New York: Oxford University Press, 1997).

11 M.K. Munitz, *Cosmic Understanding* (Princeton: Princeton University Press, 1986), pp. 231f.

12 G.D. Kaufman, *In Face of Mystery: A Constructive Theology* (Cambridge, MA: Harvard University Press, 1993), pp. 325f.

13 Minneapolis: Augsburg Fortress, 1996.

14 The ontological emphasis is prominent in R.W. Burhoe, *Toward a Scientific Theology* (Belfast: Christian Journals Ltd., 1981); the valuational emphasis is in C.D. Hardwick, *Events of Grace: Naturalism, Existentialism, and Theology* (Cambridge: Cambridge University Press, 1996) and J. Stone, *The Minimalist Vision of Transcendence: A Naturalist Philosophy of Religion* (Albany: SUNY Press, 1992).

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Chapter 12

Beyond Naturalism: Scientific Creativity and Theological Knowledge

Paul Allen

Introduction

Loyal Rue, a leading exponent of religious naturalism, has remarked 'Religion has always been about the business of adaptation, and it will remain so.'[1] Thus is stated concisely the position of religious naturalism that follows decades of reflection by many scientifically literate thinkers, whose respect for religion is tempered by a rigorous appreciation for the extent to which science provides an explanatory framework for natural reality. As Rue notes in that article, naturalism is merely the prudent application of Ockham's razor, under the weight of mountains of supportive empirical evidence for the claim that the natural order is sufficiently understood as the one order of being. There is one order of existence, the natural, not two orders of being, a natural and a supernatural.[2] Religion, for Rue and other religious naturalists, consists more of a 'mystical sense of belonging'.' For Willem Drees, the sense of belonging is specified and transposed into a prophetic stance against unacceptable realities. Beyond a naturalistic metaphysics, this stance implies a more historical understanding of religion. Thus, with Drees, naturalism gestures toward the postmodern instincts of most contemporary theology and religious studies. Drees concurs with Rue in positing that 'no supernatural world, as distinct from the natural world, shows up *within* the natural world, not even in the mental life of humans.'[3]

What are we to make of such claims? Should philosophers and theologians embrace or shun religious naturalism? Is an embrace of religious naturalism fatal for historic theological claims concerning divine creation, providence and salvation? If so, in what way is divine action evidenced in the world, contrary to the claims and evidence of scientific naturalists? If one were to make such a determination, what would be the epistemological conditions for making such a claim for divine action? First, let it be said that most contemporary theologians see no need for a metaphysical or 'realist' appraisal of divine action, for reasons having to do with the supposed 'objectivizing' tendencies inherent in such questions, tendencies that are seen as base elements for a traditional position of naive realism. Second, it is worth emphasizing that claims of divine action would demand attention to a philosophical mediation that could bear the weight of understanding how different forms of knowledge can account for the supernatural within the natural. Again, however, contemporary theology, for its part, prefers more exclusive existential, historical or ethical parameters that do not imply metaphysical or even epistemological challenges.[4]

Here, I wish to point to some of the theological issues raised by current debates over 'Intelligent Design' in order to specify a philosophical position which affirms

methodological naturalism while denying ontological naturalism. From the role of the imagination in scientific method in achieving verified knowledge about the world – a position well noted by Ernan McMullin – I argue that human creativity is itself the dimension within human consciousness wherein a supernatural dimension to the natural order is present *in potentia*.

One Way to Challenge Naturalism

At this time, objections to the dominance of Darwinism and to sociobiology are increasingly commonplace in contentious debates about the nature of nature. This is the case not only in academic media but also in popular fora. This issue has been revived partly as a result of data that point to complexity and directionality in cosmology and, now, biology, including human biology.

The issue is this: Is nature, at bottom, orderly or random? If it is really a chaotic mixture of these, how is this to be understood? What, if any, are the implications of understanding nature for a sense of human existence, morality, truth and free will? The true significance underlying these tangents is identified by Bernard Lonergan's question: 'Is the universe friendly?'[5]

Until recently, asking about the 'friendly universe' would have been judged a pseudo-question scientifically – as something only of interest to philosophy, and to speculative philosophy at that. This judgement has been supported by the development of naturalist schools of thought in philosophy. A refusal to address the question of meaning in a metaphysical sense is mirrored in epistemology too. Empiricists have argued successfully and repeatedly for retaining empirical adequacy or similar restrictive criteria centred on the existence of data to be the sole pillar of true, verifiable scientific knowledge about the universe. These positions have formed a virtual consensus. Now, naturalism and empiricism readily co-exist with other positions, and they serve as a measure for other philosophical streams of thought, particularly that of American pragmatism, as proposed by Richard Rorty.

Recently, however, there are new critiques raised against the Darwinian mechanism of natural selection, which defenders claim operates randomly. The contention is whether this mechanism is the key insight to understanding evolutionary descent with modification within and among plant and animal species. The most prominent criticism of Darwinian mechanism is now made by the Intelligent Design movement and its spokespersons, Michael Behe, Stephen Meyer, Jonathan Wells and William Dembski. Advocates of Intelligent Design believe that the irreducibly complex biochemical character of the cell and multi-cellular organisms is so statistically improbable, given the evolutionary sequence preceding its formation, that there must exist an additional power or principle known as 'Intelligence' in order to account for its complex structure. The theological implications to this surge of interest in design is clear. Not without reason, it is the possibility of a theological implication that many critics of Intelligent Design take to be the driving force behind the movement as a whole. This charge is not without warrant, but it does tend to miss the more complex and intriguing questions that Intelligent Design advocates raise about complex biological systems.

For those who tire of this movement and the bad-mannerly discussion it provokes, there is bad news. Intelligent Design, for all its exuberance and despite its dubious political agenda in the American culture wars, is, without a doubt, set to become more prominent over the next decade. This can be forecast partly on the basis that many, if not most, of Intelligent Design advocates such as William Dembski and Stephen Meyer are under 50. Whatever we make of the arguments for Intelligent Design, there are two things that can be remarked about it in general.

First, these controversies comprise a veritable scientific and philosophical feast not yet comprehensively refuted by defenders of Darwinian naturalism. Of course, this may occur in the future, but it has not yet transpired. Most opponents of ID articulate their concern over the lack of evidence to support the theory while very few delve into the complex details of probability theory that Dembski, ID's most articulate spokesperson, has employed in order to make a case for it.[6]

Second, the ID controversy represents an incredible opportunity for theologians and philosophers to come up with a reformed, more qualified naturalist position in philosophy. The naturalist position, which I defend as an adequate methodological or epistemological framework, should not just 'make room' for religious faith. It ought to acknowledge scientific and philosophical achievements in understanding nature that seamlessly lead to theological arguments for the existence of God and even the activity of God in the world. This sort of inquiry lies in the more traditional key of apologetics and natural theology. But this discourse has made little headway, since many of its exponents either assume a thoroughgoing naturalism or a crude philosophy of God which presumes an interventionist deity. Little headway has been made to mediate and negotiate the trajectories of these two options.

In spite of the complexities of the scientific issues raised by the Intelligent Design movement, there is a great need to develop a philosophical naturalism that might be more amenable to religion. Not without reason, advocates of Intelligent Design cite naturalism as the most substantial and prejudicial view espoused by their opponents in the scientific establishment. Where I agree with these criticisms of naturalism made by advocates of Intelligent Design concerns the unfailing and stubborn adherence to exclusively physical causality as the one and only possible type of explanation for all physical and mental events in the world. Intelligent Design proponents are correct that ontological naturalism needs to be challenged. The question is how.

Where I disagree strongly with Intelligent Design critiques of naturalism, however, is over their refusal to discuss the overwhelming biological evidence for evolutionary descent through a mechanism of natural selection operating randomly. How evolutionary biologists eventually want to settle on the form this mechanism takes in natural history is an interesting discussion. But this is a scientific discussion that should remain between advocates of gradualism on the one hand and punctuated equilibrium on the other hand, based on the overwhelming mountain of evidence that each side has marshalled to defend their respective views.

There are no clear philosophical or theological conclusions to be derived one way or the other as to what type of history this mechanism has taken. Certainly, the position of punctuated equilibrium should not be presumed to warrant the positing of a God-of-the-gaps, as Stephen Jay Gould has fumed. Yet, there are no a priori reasons why theologians who advocate a traditional Christian God should refuse

a methodological naturalism as thoroughgoing as any Darwinian would advocate. A methodological naturalism, as distinct from a metaphysical naturalism, is not a theological dead end.

Apart from Intelligent Design, a second example in which methodological naturalism is renounced in the name of God comes from Alvin Plantinga's description of mental dualism. Plantinga believes that our cognitive faculties are successful because of direct divine providence.[7] I agree with the bare outline of this position inasmuch as there is a distinction made between the operations of human intelligence and the more innate skills evident from animal sensation. However, the distinction takes great risks as a trajectory toward a dualistic theory when, in the name of human uniqueness, we deny the significance of contemporary neuroscientific studies of consciousness. These studies show overwhelming evidence for physical causation in brain functioning or what Plantinga calls 'event causation'.

There exist alternative approaches in the philosophy of mind that would be more congenial to a basic theist stance without setting up a fideist a priori principle for science to follow, as Plantinga does. For example, one can argue that the boundary which restricts naturalism is the fundamental limit of culture. Recent work in consciousness studies (by scientists who, one would expect, adopt a strict naturalism) confirms the enormous degree to which nature and culture overlap and interact in the human mind.

In his remarkable book *A Mind So Rare: The Evolution of Human Consciousness*, Merlin Donald concludes his study of mind and consciousness by suggesting:

> On the basis of what we know of our brain's evolution, we must conclude that the raw feel of being human is probably not qualitatively different from the raw feel of being any kind of primate. The same fundamental brain functions negotiate all primate experience: binding, short-term memory, and intermediate-term governance. But if the raw feel is the same, consciousness has gained far more control over mind and action in humans than any other species. It has also enriched the content of individual awareness, through its immersion in *communities* of mind. The differences between us and the other primates can be attributed largely to deep enculturation and the resultant reprogramming of our conscious experience. ... The nature and range of human conscious experience are no longer a biological given ... the processes of mind can be endlessly rewritten and rearranged by cultural forces.'[8] [emphasis mine]

Much work needs to be carried out in the area of philosophy of mind in order to buttress the claim that consciousness is culturally shaped, against the idea that it is strictly a biological given. Perhaps one way to think about the relationship of culture and biology in terms of consciousness is to think of operators and integrators, causal action that divides into two distinct forms, with one being top-down and the other being bottom-up. Arthur Peacocke and especially John Polkinghorne are two participants in the science–theology dialogue who have already proposed fundamental distinctions in causality with respect to biological systems and cosmology respectively. If applied more strategically to consciousness itself, this strategy could counter effectively the naturalism of E.O. Wilson, Steven Pinker and Richard Dawkins. The point here is that mental dualism will not work unless the brain itself is conceived in terms of its placement within social and cultural networks, in which case we are no longer

dealing with the traditional sort of dualism that has been effectively refuted by materialists and philosophically versed scientists. The brain cannot be conceived apart from wider cultural and social networks and, as such, cannot be conceived as the non-physical entity over and against which the physical world stands.[9]

Imagination and Realism

Apart from the scientifically-oriented debates around ID and brain–mind relations, I see an equally interesting route to appraise naturalism theologically through recourse to old-fashioned epistemology in the philosophy of science. Attention to the traditional topic of intelligence in act reveals a transcendence made actual through knowing, both in science and in theology. Intelligence acts in different ways in these different disciplines, according to the object of knowledge which is sought. This assumption underpins the distinctions in disciplines. What may require amending, however, is the importance attached to the operation of the imagination in knowing.

The scientific interest in a theory of knowledge usually centres around a cohesive, responsible form of critical realism, as opposed to naive realism or some form of instrumentalism. In standard realist accounts, the various contingent features of science are played down so as to not detract from the scripted message concerning the historical and real achievement of progress in knowledge. But in science, the contingent features of scientific rationality are not always what they appear to be. Contingency marks the history of science in ways that we now appreciate much better than when the positivists were writing about the role of simple experience in the act of verification.

Chief among the factors associated with the discovery of sheer contingency in scientific rationality is the Thomas Kuhn's insight into paradigms, those largely incommensurable periods of science in which the language, methods and experimental norms of one scientific paradigm are closed off from each other. What is remarkable about the enormous reception of Kuhn's work into the *canonica* of the humanities, however, is the fact that certain of his own qualifications of paradigms were not incorporated into the popular imagination. Kuhn showed, with outstanding accuracy, that paradigm shifts in the natural sciences were *not* brought on by the force of sheer logic. Other very strong social and psychological forces were at work.

However, one of the most intriguing aspects of Kuhn's legacy concerns his notion of values. Scientific values, operating epistemically in the process of hypothesis formulation and theory verification, stand as a peculiar feature of both theoretic and pragmatic aspects of scientific rationality. In that sense, they serve as a bridge between the two dimensions of science. These cognitive values include coherence, simplicity, fertility, accuracy and scope. They describe what, to a scientist's mind, mark adequate criteria by which to evaluate a theory. What is so curious from our standpoint, is that Kuhn, even in his famed ambiguity, did not believe that these values changed along with scientific paradigms. They were, to use Kuhn`s words, 'fixed, once and for all ... permanent attributes of science'.[10]

Ernan McMullin notes this conservative streak in Kuhn and observes that Kuhn:

> focuses mainly on changes in first-level science: in theories, in instrumentation, in textbooks and so on. He does not say much about changes in scientific rationality itself, in the second-level principles according to which the scientific undertaking itself would be directed. Indeed, he appears to suppose that in what he calls the 'mature' sciences there is a common rationality, marked by such values as predictive accuracy, consistency, simplicity and so on.'[11]

Note that these markers of rational inquiry are principles in a heuristic sense, not mere expressions of logical explanation. They are not physically necessary to the functioning of the universe; even while they explain the universe as criteria of verification, yet they cannot be properly labelled natural either.

We can go further than this. If permanent attributes of science such as these cognitive values function to interpret validly and thereby to verify scientific experiments into natural reality, why do many scientists hold to both a methodological as well as an ontological naturalism? If scientists use cognitive values that help explain nature that are themselves in principle non-physical, how can scientists proceed to argue for a purely natural framework for all of reality, including the act of explanation?

In a recent article dedicated exclusively to developing a deeper understanding of the human imagination, McMullin points to a cultural and historical problem with imagination as a cognitive faculty:

> When we speak today of 'the works of the imagination', we generally have in mind poetic and artistic creations. The assumption is that the faculty of imagination is a distinctively poetic talent ... Science, in contrast, tends to be regarded as the domain of method, of rule, of painstaking determination of experimental fact followed by tightly governed theoretical inference.[12]

In undertaking an archaeological survey of the roots of the contemporary term 'imagination', McMullin summarizes the Platonic and Aristotelian traditions as well as the later Roman writers who used and applied the Greek terms *phantasia* and *phantasma*. Then he turns to Augustine, who works out a foundational understanding of imagination in his work *De Genesi ad litteram*:

> It may be to Augustine that we owe the Latin term *imaginatio* and hence the term 'imagination'. He has much to say about imagination, in part because of its close association with one of his favourite topics, memory, in part because of its tie with the imaging relationship between the Creation and its Creator. *Imaginatio for him is not itself a faculty but a product of a faculty he calls spiritus ... Imaginatio* thus plays a part in all knowing. But in addition it may derive from the constructive activity of *spirit* ...[13] [emphasis mine]

Aquinas transposes this understanding of imagination, according to McMullin, by building on Augustine's understanding and linking it more closely with the meaning of the Greek *phantasma* – specifically as that faculty which stores and constructs new images. As comprising both of these natural and 'supernatural' sources, imagination 'creates' the forms received by sensible experience. This, of course, is where the rapprochement between the Augustinian and the Aristotelian heritages is evident.

Imagination, on this twofold view, is understandable from either vantage point. On their own, neither of these perspectives, whether natural or supernatural, serve to explain entirely what imagination means.

In his historical examination of the philosophical treatment of imagination, McMullin recounts its gradual impoverishment of meaning, beginning with the way in which Descartes associated imagination with corporeal existence and pitted it against intuition – the famous Cartesian a priori basis for scientific and natural knowledge.[14] The recovery of imagination was made by the Romantic movement, and especially Coleridge, on whom McMullin depends to rehabilitate a language about the imagination that captures the Romanticist accent on creativity in imagination in such a way as to take it beyond strictly aesthetic bounds.

McMullin argues that the rise of the sciences of the distant, with their inherently theoretical questions, involved imagination in a radical and far-reaching way. The irony is, as McMullin notes, that scientists such as Newton thought that it was a combination of strict deduction or induction that was the epistemological and cognitive basis for scientific practice. What was really going forward, however, was a much more self-reflective method in science that required a reliance on the cumulative richness and operating creativity of the human imagination.

The lack of self-conscious reflection in the history of science notwithstanding, McMullin sees the import of the rise in the use of the faculty of imagination as having a significance beyond issues of epistemology or philosophy of science:

> In the nascent sciences of chemistry, optics, astrophysics, geology, paleontology, it was not at all clear that laws, that is, observed regularities, *were* the ultimate goal of inquiry ... what was sought was, rather, the distant *causes* of these regularities, the corpuscles, comets, and long-past processes that shaped earth and the life that once inhabited it. It was an *existential* inquiry, an effort to extend knowledge of the natural world to realms far distant from the immediate range of the human senses. For this the constructive imagination was the key.[15]

As constructive, the imaginative schemes in successful theories of more and more scientific work had now to rely on what McMullin calls a 'second imagination', a qualitatively different sort of imagination where 'ordinary combinatorial powers of imagination, constructing causes and categories from elements of the familiar, would not be enough'.[16]

McMullin describes this new, second imagination as involving a whole 'categorial distance', 'an ability to understand nature, to construct physical models, even where they cannot express this understanding in perceptual terms',[17] in contrast with what was previously assumed. It was a 'shift, so discomforting to the scientists involved, [demanding] a new level of creativity on their part, [a] new quality of imagination'.[18]

It is no stretch to say that the importance of this distinction and recovery of imagination for a theory of science is critical in light of the twentieth-century accomplishments in areas such as quantum mechanics and astrophysics.[19] Without the depth of mathematically-laden imagination contributing to image formation, such complex areas of science could not explain microcosmic or macrocosmic natural processes. What is not so obvious, but just as profound, is the portrait of human rationality that emerges from an attention to the act of imaging. The actual possibility

of a radically creative and scientifically successful 'second imagination' in human rationality gives us confidence in understanding the inherently probabilistic character of the universe as both deterministically and indeterministically functional. It also helps us to see the way in which we can understand God in relation to the universe. God is not contrary to what one expects from the *telos* of the human imagination. The unobservable is nevertheless still real. The tie to the God question is clearest in light of the medieval (and contemporary) theory of analogy, which McMullin notes as an:

> obvious ability on our part to think of objects and properties that we could in principle never perceive ... God cannot be imagined by us in the ordinary imaging sense of that term. One could simply invent a new term for this ability, but it seems preferable to view it as the manifestation of a more creative level of the constructive ability we already call imagination, especially because of the role that analogy plays in its functioning.[20]

While McMullin's account of analogy is not an endorsement of a metaphysical theory in natural theology or an argument against naturalism from the point of view of rationality, it does seem to serve as an expectation that the imagination could provide clues to knowledge of God within a wider (Augustinian) theological framework.

The historical thread of McMullin's thought concerns his reading of 'physico-theology' which was associated with design arguments purporting to demonstrate God's existence. Analogical knowledge, by its very nature, makes different claims about what can be said of God from a basis in a knowledge of the world. In 'Natural Science and Belief in a Creator', McMullin notes that in the aftermath of seventeenth-century physics, natural scientists who were also believing Christians leapt into the chasm created by the demise of Aristotelian metaphysics in the face of the universality of empirical laws. Boyle and Newton, in particular, advocated different forms of 'physico-theology'. Newton's argument, in particular, consisted in a pure 'God-of-the-gaps' argument.[21] It is the subsequent collapse of physico-theology, in ways tantalizingly similar to the demise of the medieval synthesis amid the rise of voluntarist and nominalist theologies, that strikes McMullin as the core issue in relating the disciplines:

> The collapse of physico-theology in the latter part of the nineteenth century undoubtedly contributed to the growing crisis of religious faith at that time. In retrospect, it is easy to see where the trouble lay. The believer was too readily tempted, in the new scientific age, to seek for quasi-scientific validation of religious beliefs. God appears as the terminus of what purports to be a standard causal argument beginning from some feature of the natural world. [Moreover] this mode of argument ... has affinities ... with earlier Aristotelian and Thomist traditions.[22]

He draws the conclusion that physico-theology is not to be trusted in its basic conclusion. For one thing, the '"Filler of the Gaps" is hard to identify with the Creator God of the Christian tradition.'[23]

For McMullin, this critique of physico-theology extends to the contemporary movement known as process theology, which extends and builds on the work of A.N. Whitehead, C. Hartshorne and others. The challenge to a naturalist view of

religion, as proposed by Loyal Rue, Willem Drees or process thinkers is clear. It errs in two ways. First, it assumes that 'its own explanation of cosmic process is superior to the conventional one given by the astrophysicist and the neo-Darwinian biologist.' In other words, a naturalist interpretation of nature is still that: an interpretation. As such, it consists of a metaphysical overlay to the physical reality that it seeks to describe. A related example is the belief among process thinkers that:

> notions like striving are *required* for the understanding of material process generally, and evolutionary change testifies directly to the shaping action of mind. ... their approach presupposes a quite specific physico-theology, one that depends for its persuasiveness on the proposition that the categories of conventional natural science are inadequate for the explanation of evolutionary process.[24]

The problem with a naturalist position, once it attempts to incorporate religion within its purview, is its inevitable incorporation of particular concepts or notions from science that are intended to serve as a heuristic for understanding religion. That is, there is a selection made from within the scientific horizon of some aspect of science over and against other aspects of science which are excluded. This selection is taken to be the normative basis for discussing religion as a whole.

Conclusion

With McMullin's reflections on imagination in mind, I suggest that the categories of striving or emergence (another popular concept utilized in various discussions) are insufficiently distinct to account for religion and the transcendent realities that form the object of theological reflection. As a result, theologies based on ID and dualism are able to enjoy a life that they would not otherwise have in a context where theology was more careful. Combining a theological anthropocentrism with the imaginative creativity of scientific rationality operating on particular cognitive values in the context of a naturalism of physical emergence, I suggest that naturalism is sufficient for an understanding of the universe, but not in terms of which the discovery and verification of scientific theories indicate a positive and realist account of transcendence. Transcendence in this scientific usage is rather restricted in the sense of marking out true knowledge that is verified yet part of an ongoing structure of knowledge demarcated by the various disciplines. Naturalism is acceptable, but only until scientific knowledge becomes scrutinized in terms of how we know what we know.

Reflections on scientific knowledge that involve a judgement of fact are reflections ultimately about oneself that indicate a transcendence of self. A view of the universe ceases being about nature, and becomes a knowledge about a reality that transcends nature. The imagination is the heuristic for this possibility of simultaneous knowledge of nature and self-knowledge. Our understanding of the universe is a quest that cannot be fully accounted for in terms of physical causation, even though we should be expected to follow a methodological naturalism in searching for physical causes for the events and characteristics of natural entities. In terms of what this implies for a philosophy of mind, the emergentist position is the one that correlates best with

the portrait of transcendence with naturalism. A philosophy of neuroscience may be uniquely able to support emergentism in philosophical theology.[25]

Methodological naturalism and imaginatively-based transcendence constitute complementary philosophical routes to emergentism that might re-define the naturalists' 'striving' as self-reflexive activity, the accomplishments of mind and the human spirit. McMullin himself does not make this kind of extension to his argument, although he crafts the basis of some elements for such an argument. His alternative to this contemporary process option is, as he says, 'the one that harks back to Augustine'. On this theological account, there is '[f]or the Creator ... neither chance nor necessity: only a single Act in which *all* comes to be'.[26] Why Augustine? Augustine is the one theological figure who incorporated three key elements that are at issue here: a) a neo-Platonic framework for understanding the discreteness of mind or soul, b) a key role for the imagination and the distinctive world of salvation history, and c) a narrative and personal view of human meaning as both separate from the world of nature and more directly the object of theological inquiry.

One advantage of the Augustinian route is the preservation of the autonomy and integrity of the natural sciences. Certainly, this empirical position coheres with a traditional Trinitarian doctrine of God. While Augustine's hermeneutic is potentially helpful, McMullin confronts a major problem of which ID advocates and dualists such as Plantinga are keenly aware. The dilemma concerns the fact that systematic theology in a naturalist framework falls on the problem that 'God does not *seem* to make a difference ...'. Equally vexing are those strategies that hinge on the necessity or plausibility of an interventionist God.[27] This is what makes naturalism such an attractive option today, especially if we recall that theology is much more specifically oriented as a discipline to the forces and elements of history rather than nature.

The solution to the problem of naturalism does not necessarily depend on either an Augustinian or a Trinitarian account that might fit with an account of nature on their particular categorial terms. Rather, the solution involves a theology that begins by acknowledging contingency and a portrait of human rationality as imaginative and self-transcendent. This is where the naturalist interpretation of religion fails to see the existence of transcendence that is manifestly real in the act of inquiry itself. In fact, the primordial aspect of understanding inquiry is basic to an adequate theological anthropology. Scientific inquiries meet the limit of inquiring into inquiry itself through imagining the ways in which empirical data fit theories through the filter of cognitive values. The presence of values and meaning in science extends toward an affirmation of a personal God of salvation history. The effort to construct this coherence is the task of systematic theology that assumes the work of theological anthropology. This function or specialty of theology is one step removed from the demands of faith, even though it mediates faith with culture according to the classic definition *fides quaerens intellectum*.

Notes

1 Loyal Rue, 'Religion, Generalized and Naturalized', *Zygon*, 35/3 (2000), p. 587.

2 Rue, 'Religion, Generalized and Naturalized', p. 598.

3 Willem Drees, *Religion, Science and Naturalism* (New York: Cambridge University Press, 1996), p. 12.

4 There is a long history to placing theological meaning exclusively in connection to symbols and myth. Rudolf Otto was an early advocate of the positive value deriving from this approach. See his *Naturalism and Religion*, trans. J. Arthur Thomson and Margaret R. Thomson (London: Williams and Norgate, 1907). Writing against the physico-theology tradition, Otto comments: '... Nature was too much studied with reference to her harmony ... People were far too ready to reason from finite things to infinite causes, and the validity or logical necessity of the inferences drawn was far too rarely scrutinised ... Long before these had been studied, religion had arisen from quite other sources. These sources lie deep in the human spirit, and have had a long history. To trace them in detail is a special task belonging to the domain of religious psychology, history and philosophy.' (pp. 7–8).

5 Bernard Lonergan, *Method in Theology* (New York: Seabury Press, 1972), p. 117.

6 However, see Kenneth Miller, *Finding Darwin's God: A Scientist's Search for Common Ground between God and Evolution* (New York: HarperCollins, 1999).

7 See, for example, Alvin Plantinga, 'Advice to Christian Philosophers', in *Faith and Philosophy*, 1 (1984): 253–71.

8 Merlin Donald, *A Mind so Rare: The Evolution of Human Consciousness* (New York: W.W. Norton, 2001): pp. 320–21.

9 For a standard account of this relationship between brain and culture, see Leslie Brothers, *Friday's Footprint: How Society Shapes the Human Mind* (Oxford: Oxford University Press, 2001).

10 Thomas Kuhn, *The Essential Tension* (Chicago: The University of Chicago Press, 1977), p. 335.

11 'The Shaping of Scientific Rationality: construction and constraint', in Ernan McMullin (ed.), *Construction and Constraint: The Shaping of Scientific Rationality* (Notre Dame, IN: University of Notre Dame Press, 1988), p. 2.

12 McMullin, 'Enlarging Imagination', *Tijdschrift voor filosofie*, 58/2 (1996), p. 227.

13 McMullin, 'Enlarging Imagination', p. 231.

14 McMullin, 'Enlarging Imagination', p. 235.

15 McMullin, 'Enlarging Imagination', p. 248.

16 McMullin, 'Enlarging Imagination', p. 258.

17 Ibid.

18 Ibid.

19 For an excellent overview of a number of episodes where the scientific imagination is crucial to progress in science, see Gerald Holton, *The Scientific Imagination* (Cambridge, MA: Harvard University Press, rev. ed. 1998).

20 Holton, *The Scientific Imagination*, p. 253.

21 McMullin, 'Natural Science and Belief in a Creator', in Robert Russell, William Stoeger and George Coyne (eds), *Physics, Philosophy and Theology* (Vatican City: Vatican Observatory, 1988), p. 66.

22 McMullin, 'Natural Science and Belief', p. 67.
23 McMullin, 'Natural Science and Belief', p. 71. The Augustinian ring to this judgement is unmistakable.
24 McMullin, 'Natural Science and Belief', p. 73.
25 See Philip Clayton, *God and Contemporary Science* (Grand Rapids: Eerdmans, 1997) and 'Neuroscience, The Person and God', in Robert Russell, Theo Meyering, Nancey Murphy and Michael Arbib (eds), *Neuroscience and the Person: Scientific Perspectives on Divine Action* (Vatican City: Vatican Observatory; Berkeley, CA: Center for Theology and the Natural Sciences, 1999), pp. 181–214.
26 McMullin, 'Natural Science and Belief', p. 73.
27 McMullin, 'Natural Science and Belief', p. 74.

PART IV
Conceptual Issues

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Chapter 13

Can Science Provide Evidence for Metaphysics?

Leslie Armour

Can science provide evidence for metaphysics? By 'metaphysics' I mean a view of ultimate reality in the sense of the most general characterization of what there is. Materialism is one example, and idealism is another. I shall answer 'yes' to the question as it applies to a kind of idealism which I believe to be true. By 'science' I shall mostly mean physics and physical cosmology considered as orderly attempts to construct theoretical accounts of the positions and interrelations of particles, waves, strings and so forth through space and time. Biology and the social sciences will enter into the discussion more briefly.

The metaphysics that I think is relevant is idealist, but 'idealism' is not a very clear term. Idealism is sometimes taken to be the view that only minds and states of minds exist, but the original sense is that 'idealism' is the doctrine that ideas exist and are somehow primary in the list of what there is and are irreducible to anything else. The relation between the 'mentalist' view and the 'ideationalist' view is seldom very clear.

My view is that the world is more like a book to be read – a book that has several readings – than it is like the sort of place materialist philosophers have often imagined, a collection of solid lumps of matter. But it is also a book that has actual readers and it is this fact, together with the fact that the book is inexhaustible and that it has more than one reading, that is central to my account. I think that reality is intelligible and that it is suffused with intelligence.

My claim, then, is that contemporary physics and cosmology provide evidence – not the only evidence, but some evidence – for the view that reality is to be understood as a set of symbols that can be interpreted in a way that makes some interpretations better than others, but that they do not yield a univocal reading.

What is meant by 'evidence'? 'Evidence' is most commonly, at least as the word and the concept have become embedded in our intellectual lives, a legal notion. People in the sciences more often talk about data and their bearing on theories rather than evidence and its bearing on judgement. But it is judgement in a fairly ordinary sense that concerns us here.

In the words of a legal decision, evidence is 'that which brings to the mind a just conviction of the truth'.[1] In this case what we are looking for is a reason for adopting a world picture. The question is whether what we know on the basis of the sciences fits one world picture better than another. We need some account of a world picture and of evident alternatives and we need some idea of what fits. The overall drift of finds, say in physics, is, of course, akin to expert testimony in the law. It is not

something one can make up for oneself, but it also requires some judgement as to what counts as expert testimony and that, also, is not itself part of science.

Our quest is certainly not like the classroom paradigm of a 'hypothetico-deductive' procedure in the sciences themselves. One version of science is that we begin with hypotheses from which we can make predictions, and then we look to see if they are sustained. But certainly not all and probably not much of actual science is quite like this. Most of it consists of fitting what we have gathered from other investigators into an intelligible pattern that explains some region of our experience, and then seeing what would fill in the gaps in our explanations and trying to find something that would corroborate our ideas, or more effectively very often, as Karl Popper insisted, what would disabuse us of the relevant beliefs. Metaphysics is rather like this, though the attempt to understand our position in the world at large has complications, especially about our own part in the story, that quite often are missing from the sciences.

The view of the world that I am advocating is not new. Scotus Eriugena (John the Scot) put forward a version of it in the ninth century.[2] It is suggested by Bishop Berkeley's claim that nature is the natural language of God,[3] though other views often associated with Berkeley's – views that lead to a strict mentalism – are not part of it.

Something of the reasons they had for such views will emerge as we go along, for the general issue about what could count as reasons for holding metaphysical theories must arise. But initially I am concerned with the question of whether or not science might provide new reasons for holding such a view.

I am not saying, of course, that physics is a kind of metaphysics, but it is no more surprising that physics should provide reasons for taking a certain view of metaphysics than that metaphysics should predispose one toward certain views of physics. Metaphysics is about what there is in the most general sense. Physical cosmology deals with what there is in a sense which can be said to be less general only if one is rather careful to say what one means. Cosmologists talk about 'the universe', usually in the singular. Theories about 'multiple universes' turn up in special circumstances. For instance, there are those who believe, on the basis of quantum theory, that the universe divides constantly so that reality does not 'choose' between two possibilities, but instantiates both. But though these universes branch, the branches still form a single tree. Physicists mean to include those branching universes in a general way in the list of things they can study, though, as the universes divide, all but one is closed to us.[4] They admit that some divided universes are not open to inspection though their existences can figure in theories. But they often suggest that, if anything could not be studied by physics in any sense, then it would not figure in reality.

Physicists, as physicists, may not be interested in prayer, but if the prayers of the Archbishop of Canterbury are unlike those of the Bishop of London, this fact must figure in the Archbishop's brain states and so have a place in the universe physicists study. God, if there exists such a being, must make some difference to the physical universe, and immortal souls, if they exist, must contain information. If we could know what that information was like, it would surely cause us to make some adjustments in what we think about information theory. Still, while physics

might be all-inclusive, it can only concern itself with some *aspects* of reality, and metaphysical theories must contend with all aspects of it. Whether God is good is not a question for physics, nor is the question of whether Professor Roy Harris was right as a young student to reject the novels of Jane Austen on aesthetic grounds. But the question of whether Professor Harris's linguistic theories rightly describe the relation between language and reality might bear, as we shall see, on both physics and metaphysics.

I shall divide my enquiry into two parts. In the first part I shall ask about how physics does in fact impinge on metaphysics. In the second part I shall seek to show that this relationship suggests quite strongly the sort of metaphysics I want to defend.

How Physics Impinges on Metaphysics

There are two immediately obvious ways in which physics might impinge on metaphysics. First of all, physics depends on the claim that the world has certain properties and, secondly, physical speculation creates philosophical problems.

To begin with, what can be studied in physics includes at least the properties of things that occupy positions in space and time, and the basic structures of this collection of things should tell us something about the ways in which being is manifested. Let us start with a simple example.

Philosophers from the Greek atomists onwards have sometimes supposed that the world is composed of lumps of hard stuff which have two sorts of properties. The ability to bump into such things and move them around comes to mind and has often been thought important. This is doubtful. But at least two other sorts of properties are required for theories which are 'materialist'. One sort of property consists of characteristics whereby objects turn up in scientific measurements and register themselves on scientific instruments. The second necessary sort of property is whatever it is that enables descriptions of such objects to figure in explanations for what we experience. It is convenient to think of these properties as consisting of the ability of our instruments to intercept or interact with particles or waves of certain sorts.

But there are many varieties of scientific enquiry. And if some enquiry – scientific history for instance – suggests that the movement of physical particles doesn't explain everything, then this has to be weighed by metaphysicians, and it should alert physicists to the limitations of their own world view. In the end, indeed, to accept the results of scientific enquiries is to accept some view of what the world is like.

It might seem that one could avoid this conclusion by saying that all that matters is that science can predict, or, in the most general terms, that it works – that it gives us power over nature, helps cure our ailments, enables us to find our way around the universe, and so forth. But no one who holds such views thinks that what he or she is saying is just that some bits of science have worked in the past. They believe that they live in the sort of world in which there is a modicum of order, in which one can talk sense, and in which it makes sense to make predictions. It is not always

quite grasped that even a rather sceptical empiricist like David Hume had some metaphysical commitments. Hume believed that we live in a world in which, if there is any knowledge, it is more likely to come from our sensory impressions than from anything else. This was partly because he thought the senses were our only possible contact with the world, and our ideas as he called them were assembled out of such contacts. He thought we were aware only of impressions and ideas, and so there was a curious point involved about how one decides just what can be experienced or what counts as experience. But Hume believed that the world was stable enough so that one could talk meaningfully in it – that one could begin and end a sentence in the same world (one world did not vanish in a twinkling only to be replaced by another) and could know that the sentence one was ending was the one that one had begun.

Specific Cosmological Theories

Specific physical cosmological theories also spawn philosophical speculation. Such theories force us to confront questions about explanation itself. For instance, some people think that 'big bang' cosmologies leave room for and even suggest the existence of God, and that 'steady-state' cosmologies have theological consequences too. Steady-state theories tell against a God who arbitrarily creates a universe at a specific moment, the first moment in time, because there is no such moment. But they may suggest an eternal abiding presence of quite a different sort. For the purposes of metaphysics, it is important to notice certain features of the logic of such theories.

'Big bang' theories trace the universe back to a 'singularity', an event behind which we cannot go. A 'singularity', by definition, is not part of a law-like process; that is, it is one of a kind, and the kind has no other instances. Causal chains in time end with such a singularity. There are many accounts of such singularities. A standard one in physics is that the point of the big bang is one of infinite density and temperature. All equations go to infinity.[5]

If one thinks of such an event in space, it is localized in the sense that there are no other events that could define a space around it. Nothing can count as an 'explanation' for it. It thus cannot exclude any other interpretation. In principle, therefore, there have to be alternatives to it. Systems that do not trace back to any original event, that go back infinitely in time and that can extend indefinitely in space are all in a special sense part of 'steady-state' theories. For aleph-null, the smallest infinite number, plus or minus one, is always aleph-null. Many things can happen in infinite universes, but they do not add to or subtract from their universes. In such universes every possible state of affairs should occur, for what it is to be possible is to occur at least once in an infinite series. In such universes there will therefore be at least one apparent universe in which all available information terminates with a big bang. Perhaps there will be infinitely many such universes. The two kinds of theories do not, therefore, really exclude one another. One must expect that there will always be a new form of the steady-state theory and that there can always be a case for a big bang theory. Indeed, I suppose that this has proved to be so.

This is in a special way evidence that the universe is the kind of place which has a variety of interpretations. How we are to read the universe will depend importantly

on what reasons we have for telling one kind of story rather than another. A strictly materialist universe would surely consist of things which had univocal descriptions, not symbols to be interpreted.

And so Sir Arthur Eddington decided, as traditional ideas about matter were demolished by a series of developments in physics, that idealism must be true.[6] Sir James Jeans[7] had a slightly different idealist vision in which God mathematicizes. Both greatly annoyed Susan Stebbing,[8] but she supposed that they were both using physics as direct support for a metaphysical theory, and, indeed, Eddington and Jeans certainly tended to read the mathematics of physics literally into reality rather than, more plausibly, arguing that what was going on was that the universe needs interpretation.

Eddington and Jeans had a point even though this mixture of science, religion and philosophy seems slightly suspicious to most of their readers. Eddington, a Quaker, was keen to see intelligence shining through the universe. But he was less clear about just how God might fit in. And indeed there is a certain awkwardness. Einstein did not think that God would throw dice, and a non-dice-throwing God is a bit of an embarrassment in a world of probabilistic physics. We should accept, however, that how we choose between theories may well depend on what other stories we have to tell, and the theistic story is supported by other reasons.

A few philosophers think that God and the big bang go together. Others no doubt would think that Aristotle's God goes better with steady state theories. Still others would think that a much older goddess who has gone by many names, but whose essence is chance, must rule. Among the 26 essayists in a recent anthology, *Modern Cosmology and Philosophy*,[9] half a dozen clearly incline to theism or at least deism, and others I think would suppose that one's choice of cosmologies must tilt the balance for or against such hypotheses. Just how is not so certain: chance is much in the background of both physics and biology, even if Einstein was not alone in thinking that no likely God would create a cosmic Las Vegas. The question of how the traditional arguments for the existence of God bear on the possibility of a gambling God has not been much explored.

The Structure of World Pictures

Let us ask a little more about how the arguments about physics and cosmology work. Physics provides one or more samples of what is usually called a 'world picture'. It has always been true, of course, that widely held 'world pictures' influence metaphysical thinking. Christianity provided its own picture for a long time, grafted on to different forms of ancient philosophy. But a God in his heaven high above the world, busy popping people into a hot hell far below the world, no longer fits very well with our scientific cosmologies. I have heard it rumoured that when in 1950 (or a little before) the Vatican was considering what advice to give the Pope about the dogma of the bodily assumption of the Virgin Mary, someone consulted some physicists. One said: 'No problem. If she is travelling as she must be in a body which restricts her to speeds slower than the speed of light, she cannot have gone very far in 2,000 years. She is no doubt still going and eventually perhaps we shall find her.'

This mixture of pictures was not welcomed. So Christianity – if one wants to stick to its story – will have to be grafted on to a different world picture.

The mechanistic science of the nineteenth century certainly produced its own world picture. Ideas about evolution in fact modified that picture and eventually brought chance back into play. Developments in physics sustained this change. When physics began to abandon the notion that the world is composed of a lot of lumps of simple hard stuff and to attend closely to the role of observers – first perhaps in relativity theory and then in quantum theory – the idealist metaphysics of Eddington, Jeans, and Richard Haldane[10] followed.

Idealist metaphysics was not the only philosophical response, however. Evolutionary theory produced its own mixture of philosophy, science and religion. It is not so easy to get at the roots of all this. Adolph Grunbaum has noticed that cosmologists make assumptions which are not simply borrowed from the scientific milieu.[11] We do not much like the idea that things spring from nothing without explanation. Two sets of concerns lie behind this dislike. Neither derives from the particular facts of physics. Nonetheless, one certainly does derive from considerations about scientific *explanation*. (The theory of scientific explanation is about physics, not part of it.)

If you allow that something can ever spring from nothing, it is hard to know why 'it just happened' should not be a good enough response to anything. For if things can 'just happen' once – even at the beginning of the universe – they can surely just happen anywhere, anytime. Whatever 'just happens' has, by definition, no explanation.

But there is also a religious background. If things can and do just happen, then religion can have no grip on our reason. The Judaeo-Christian tradition seems to be above all a tradition of concern with origins – a tradition which suggests that origins provide a tip about the future. If we come from God, we have a chance to return to God. The notion that the origins of things are a clue to their futures is equally embedded in our science.

That is why, I think, that early in this century we had a flurry of evolutionary philosophers who produced what may be an alternative to the idealist reading. Samuel Alexander,[12] Conwy Lloyd Morgan,[13] Teilhard de Chardin,[14] and perhaps Alfred North Whitehead[15] and John Elof Boodin,[16] were among them, though in the end idealism of a rather Neoplatonic kind predominated in Boodin's mind. The philosophers I have named tried to use science to support their philosophies, but Henri Bergson mixed evolutionism and a critique of science.[17]

Important strands of these philosophies remain, but Whitehead's work continues most strongly in theology, as does the work of Teilhard de Chardin, and it is not his *élan vital* or his critique of biology, but his critique of knowledge that survives from Bergson. If Boodin were much read, it would be his Neoplatonism that attracted attention these days.

The biological and evolutionary issues have not gone away, but they turn up now as questions about how to understand the 'anthropic principle', and with regard to what kinds of 'fine-tuning' are necessary to have a universe in which Fred Hoyle can think about how life was imported from distant parts of the universe, and Stephen Hawking can struggle so effectively with his handicaps. These issues also turn up

in the questions posed by John Leslie about whether and how the world might come to an end.[18]

The great sweep from the first particles to Teilhard de Chardin's God or Samuel Alexander's ever-receding deity does not attract much attention when astrophysicists and philosophers get together these days. It does, however, illustrate once again the fact that our scientific theories provoke ways of interpreting the universe and suggest that it may indeed be the sort of place that can be grasped only through interpretation. Neo-Darwinist evolutionary theory is a kind of puzzle. It does not enable us to predict (as I think some people once hoped) the future of the human race or indeed the future of any organism. For we cannot tell how random chance and genetic disruption will turn out, only that, whatever happens, the environment will sort the survivors from the losers. And Jerry Fodor has provided a strong argument against the notion that evolutionary theory explains anything.[19] It is just too unlikely that random chance and environment could lead to the curious evolutionary events we find for them to figure as an explanation, even if the theory is true. One should not get this fact wrong. No rational enquirer doubts that evolution is a fact – as Ernst Mayr has lately insisted.[20] There has certainly been a development of life on this planet. The amoeba was here before we were and there is a continuity of genetic development. Natural selection is a part of it because species do tend to reproduce until they fill their environmental niches, collide with one another and their environment, and get thinned out. But the Neo-Darwinist interpretation which puts everything down to chance and natural selection is not necessarily the right answer.

The evolutionary story has to be interpreted. It *can* be interpreted, but the results are various. With some added premises we can view it as a meaningless wander through space–time by some interesting molecules, or it can be given meanings such as those that Alexander and Teilhard favoured. It is often suggested that the 'meaninglessness' hypothesis needs no support, but simply follows from the facts. Meaning has to be added. But this is not true. For a hypothesis that neither predicts nor explains seems to have little foundation among usual claims to knowledge. The meaninglessness hypothesis, as much as the others, does need extra premises if the theory is to hold its place in the scheme of our knowledge. One of the premises, of course, is that there is no other source for insight into our choice of interpretive hypothesis. Another is that a theory that neither predicts nor explains is intelligible. Of course one can say that all we are doing is fitting the data together into a neat set of boxes that seem to accommodate all of them, in which case it does not matter much if there are empty boxes – gaps in the evolutionary story – or if we cannot guess from the contents of one box what is going to be in the next one.

There *are*, though, other sources of information. Alexander used a philosophical analysis of space and time. Teilhard de Chardin grafted his theory onto his religious insights. One may dismiss these. But the theory that the universe is a kind of randomizing machine also does not follow from the scientific data. Is such a theory any more plausible or less committing?

Once again, the point is only that the world needs interpretation. The refocusing of the issues via the anthropic principle on questions about ourselves and how it is that there can be a universe in which we can pose our questions, may give new life to

talk, among the philosophers who draw on science in its cosmic sweep, of the ways in which idealism may come back to life.

This talk may be bolstered by the fact that one might argue that, in the work of Quine, science and technical philosophy conspired to produce what is really a linguistic idealism. This fact is gradually being noticed. And one need only open *Radical Philosophy* to see that its significance is slowly being grasped.[21]

Two Great Issues Posed by Philosophy and Cosmology

I would argue that two major issues are posed by philosophy and cosmology. One is about the continued presence of theories which in principle necessarily form alternatives. The other is about explanation itself.

In fact the presence of alternatives, the lack of absolute determinacy, poses two quite different issues that relate to physics and physical cosmology. One of them is simply the measure of uncertainty. The other – perhaps more important – is that the world may actually be properly described by predicates which are complex and involve alternands. The truth about the world may be that when we ask if the world is 'a' or the world is 'b', we may not want to say that it is one or the other, but that it has the complex property 'a-or-b'.

Much of physics, especially at the level of very small entities, is agreed to be probabilistic, though the correct reading of this fact is also one of the issues which is subject to contention. For the vast agglomerations to which cosmological theories are directed, the same thing may hold. It would appear that reality is capable of different equally legitimate readings. Thus Kafatos and Nadeau[22] say the evidence in cosmology suggests that there will 'always' be alternative ways to interpret the results.

Let me explore this a little further. I suggested that there is a special sense in which the 'big bang' cosmologies could not possibly be 'exclusive' explanations. They trace the universe from a unique event at which the cosmic time from which we measure states of affairs in our physical universe begins. The theory does not rule out competitors.

Both 'big bang' and 'steady-state' cosmologists accept that our universe contains 'black holes'. Black holes are so dense that little energy (at one time it was thought no energy) can escape from them. The matter seething there cannot expand into our universe. Indeed, matter in a black hole concentrates around a centre, as Brian Greene suggests.[23] Greene and his co-workers have done considerable work on the notion that spaces can tear and recreate themselves in new forms. Conceivably a black hole can implode,[24] creating a space of its own. Our universe might be a black hole in another universe and so on ad infinitum – giving rise to a steady-state universe much like an ever expanding Swiss cheese. (Each black hole is leaky, so they would all be emptying out – only to be replaced by new ones.) But we have a choice of theories even if this is true. If our universe is a black hole in another universe, that other universe does not appear as a feature of our universe. We can track our universe back to a singularity and (so far as the evidence we have today goes) regard all the black holes we actually find as being contained within our universe.

The Centrality of Infinity

Behind such controversies, as I also suggested, looms a larger one: do we live in an infinite or a finite universe? The 'Swiss cheese' universe I speculated about is in principle infinite and may in fact be so. The big bang universe is finite in space if it contains enough matter to make it come back on itself, but it might be infinite in time if there is a yo-yo effect.

One can argue that we will always have a choice between infinite and finite universes if we confine ourselves to physics. Infinity keeps cropping up – we cannot keep it out of our mathematics. Finitist physical theories are possible. Yet there seems to be an alternative infinite theory. Once again reality is presented as having more than one reading. If we must decide between them, we shall have to do so by bringing to bear considerations which do not belong to fields like astrophysics.

We are a long way from the world of 'hard lumps of matter' of nineteenth century physics. The data we receive from our senses can be ordered in mathematical ways and then interpreted to give an account of the way things do and will behave. At its most abstract level Brian Greene, who is accepted as the leading 'string theorist' of the moment, has argued that reality, from a physicist's point of view, consists of tiny loops that vibrate in various ways, becoming electrons, photons and gluons.[25] These are not things we can ever see or directly confront. Nor are the next level of particles things to be seen. Photons enable us to be seen and to see other things, but they cannot themselves be seen. If they could, we could see nothing else. We arrive at such theories by giving a coherent reading to the things that we see and touch, though, indeed, the data of contemporary physics comes mostly from machines that produce not pictures but numbers which tie into our mathematical theories.

What Theories Do

Such theories take their strength from observed data. But they do not describe the data. Rather they organize the data so as to make sense of them. If we put together the notion that the universe is 'open' in the different sense that its reality consists of complex predicates, with the notion that it is something to be read in the way that symbols are read and understood, we come to see how the universe has more than one reading. The issue is not just that there is more than one theory which matches the facts, but that, in principle, there is a variety of theories acceptable by any rational standard.

The universe of discourse in which our knowledge is expressed seems to point to a reality which is more like a set of symbols than like a set of hard lumps of matter. This deserves a little thought. For it raises the question of how language grips reality. Roy Harris has noted that there are three theories about the 'semantic' relation:[26] the surrogationalist theory, the structuralist theory, and the integrationist theory. For once, the words mean what they seem to. Most accounts of how science describes the world use words as 'surrogates' for things – each word stands for some element or set of elements in reality. The structuralist thesis is that the meanings of words are determined by their relations to other words. Harris's account of the 'integrationist'

theory is that words are 'cues' for interpretation. Their meanings shift with each interpretation. That is, on the two last theories words do not stand for things, but rather grip reality through large theoretical systems of meaning, and on the last, integrationist view, there is a necessary plurality of such systems because each of us must make a reading from where we stand in the centre of a pool of experience which we share with others through the languages that we use.

Once again, from the whole drift of theories in physics it seems that, by its nature, reality can be given many interpretations. Our cultures, as well as the predilections of scientists whose views carry the day, have much to do with the ways in which we read these symbols. We do not make up our science. The symbols are really there. But we do read them.

Ideas of Explanation

A closely related set of problems is about explanation itself. Both the 'big bang' and the 'steady-state' cosmologies – the two rival theses of which I have spoken briefly – end in something which defies causal explanation. One cannot get behind the 'big bang'. Once the 'big bang' universe gets going, its affairs are thought to be guided by laws of physics and chemistry, though this may be troubling. Steady-state universes have no beginning in principle, so they have no cause. But within them, again, normal business goes on in physics and chemistry. It is just that causal explanations take place *within* a theoretical framework beyond which we cannot go.

Yet these theories are puzzling. Why should things be like this? The temptation is, of course, to turn to theology and say, well, God wanted it so. But this is no help unless we have some clue about what the God who is being postulated would have wanted. And theologians have not found out much, I think, about God's taste in physical cosmologies. Some think He or She liked to (or had to) create things *ex nihilo*, and others that God created things because they are good (suggesting that the Good was independent of God and its reality was logically though not temporally prior to God's). Still others believe we cannot penetrate the mystery.

The trouble with mysteries is that they are infectious. If some things can be left without explanation, all explanations are placed in doubt. That is, any happening whatever can be ascribed to this mysterious force. For a mystery *by definition* has no known limits and no known modus operandi. Cosmology might help us with these problems, though. We have seen that our cosmologies tend to involve us in infinities. The very language in which we speak of them has an infinite dimension.[27]

The shadow of infinity crops up everywhere. We can never quite squeeze it into our world, though, as Samuel Alexander said, it may lead us on.[28] An infinite universe is full of paradoxes and puzzles. Aleph-null is the smallest infinite number. Aleph-null *plus or minus one is still aleph-null.* In an infinite universe, moreover, everything with a probability of greater than zero should occur at least once, for what it is to have an assignable positive probability is to occur at least once in an infinity of chances, and unless some effective notion of individuality can be adduced which prevents the result, everything in this class should occur an infinite number of times.

This would seem to make nonsense of much that we say about the world, including our own behaviour. For if I do not do x today, there is someone else just like me except that he did do it. Nothing matters much.

Yet if we think of the universe as an infinite set of symbols capable of infinitely many finite interpretations (so that the ultimate infinity is the source of things but always just beyond them, as Alexander thought) and stop thinking of a universe with an infinity of bits of matter, the paradoxes disappear. There may be infinitely many things to be read and infinitely many readings, but there need not be infinitely many readers of them.

In the traditional Judaeo-Christian theology God is normally taken to be both infinite and good. The tendency for infinities to be expressed in our world is, as both Descartes and Nicholas of Cusa thought, one of the signs of God at work.

In the end, as I have suggested, a whole world cannot be explained by anything in it. For that thing itself would need a further explanation. Only something which is real but not a thing in the world will do. John Leslie inclines to the view that God, for instance, can be self-creating, but the explanation for this very possibility, he would agree, is that this is how things are because this is how they ought to be. Goodness is logically prior to God. From Leibniz to John Leslie this idea has been important.[29]

If one were to make something theological that could be seriously defended out of this, there would have to be a connection between the goodness and the infinity of God. I think there is. It is because God is infinite that moments of goodness can appear in the world, however bad things seem to be. God can in fact be good under any circumstances. That is, the meaning of our lives hangs on the fact that we are always capable of goodness because we are inexhaustibly infinite in ourselves, possessing within us, as the tradition has it, a nature which is the image of God. Human beings rise above all the systems they envisage because they have a dimension of infinity in themselves. Their possibilities can never be exhausted. As Nicholas of Cusa said, we are second Gods. [30] It is this which has been taken to be the image of God within us. Cosmology surely offers a reason to consider such ideas.

Deciding on a Metaphysics

Two lines of thought seem to emerge from the ways in which science has in fact impinged on metaphysics. One is that reality is not univocal. What is strongly suggested is that there are many interpretations of reality. They are not in principle reducible to one. The other line of thought is that we cannot divorce ourselves from the scientific pictures.

It is important not to get either idea wrong. Not all interpretations of reality that have some scientific backing will turn out to be sustainable. The sciences are constantly discarding some theories and promoting new ones. But reality seems to be the kind of thing that demands interpretation. And the fact that we cannot divorce ourselves from our descriptions of reality does not mean that everything is subjective. It is an objective fact that not all observers will report events as having the same order in time, and an objective fact that all our observations make a difference to the world.

We often talk of building the 'scientific world picture' as if that were like the once-popular view of taking a photograph, for we naturally fall into the patterns of surrogationalist linguistic theory. But the process is much more like that of reading a book and searching for interpretations of the text that make coherent sense than it is like pointing the camera and getting the right image. And, in any case, we have long since learned that photography is an art, too. It matters how you point the camera, what the camera's own internal properties are, how you develop the picture, and so on. There is no one best picture of the Eiffel Tower, and despite – or perhaps because of – Andy Warhol's endlessly repeated images, there is no best representation of Marilyn Monroe, and even a Brillo box can tell many stories. Science is like photography and a little like literary criticism. No one thinks that *Paradise Lost* has only one reading. There is no best picture because the object to be photographed is not so simple that it can be fully grasped in one click of the shutter, and when artists choose to paint an identifiable object, the object is not exhausted, either, by a single best image. And no text has only one reading.

I am not here making the case for the subjectivity of the sciences or for what is sometimes mysteriously called the social construction of reality. There is indeed a reality, but it consists more of symbols which are to be read or understood. I said at the beginning that my theory was somewhat like Berkeley's account of nature as the 'natural language of God'. But Berkeley also thought that the book which is the world probably had a single best reading. This is doubtful, maybe impossible. We will perhaps see why better when we have looked at the second great issue, our own relation to reality.

This issue is raised because we cannot divorce ourselves from reality itself or from the readings we give to it. Whether we should be disturbed by this or not, of course, depends on what reality is like.

The ideal world from the point of view of someone who wanted a univocal description of reality would be one in which the world consisted of simple particles like billiard balls, each of which had its own unique description and which interacted with the others mechanically with the simple push-pull of traditional efficient causes. But whatever else is in dispute, physics seems to tell us that reality, whatever it is, does not consist of lumps of hard stuff which are simply 'out there'. No one any longer believes that the world runs by bits of matter bumping into one another. Rather explanations depend on the form of things. Gravity is caused by the curvature of space, but space is defined by the things in it. Space and time, the very central stuff for what makes for physics, can be conceived in any number of ways. Thus there is no simple description of any object at a moment in space and time – only a description of its function in a large system whose properties are given by mathematical equations. These can be interpreted in various ways, and are, as the need arises. But it is a long-standing truism that light can be conceived as a set of particles or a set of waves depending on how one reads the system, and even at what point one decides on the description of a single process. One can read the world as a set of particles and the forces that govern them, or as a set of fields whose changing properties are simply represented by mathematical equations. When one pushes the analyses, one may find other choices. One may prefer theories which see the ultimate reality as vibrating strings rather than as a set of particles or waves.[31]

Theories will always come and go, of course. But one must emphasize that the issue is whether or not it is matter of *principle* that we will not get a single univocal description. If it is just a feature of the facts we currently know, then the metaphysical implications will disappear. The issue seems to be this: if it were just a passing phase of our learning, then reality would have to consist of objects that could have single descriptions. For this to be true, it would have to be the objects that we confront in the laboratory that are primary and not the theories in terms of which we identify those objects.

Loosely, physicists doing experiments talk of getting 'good numbers', that is, theory is predominant. This is just one example of what we have been seeing.

Theory is predominant because the objects that are being talked about are not objects of direct observation. If we could see photons, we could see nothing else. Electrons animate our microscopes but do not reveal themselves. The 'up' and 'down' quarks – named by physicists who read *Finnegan's Wake* – cannot be carried into the classroom for show-and-tell. Complicated experiences – ranging from exotic bubbles in chambers filled with beer to flashing numbers revealed by lights on counters – are comprehensible only in terms of theories that allow one to read them. Physicists like Steven Weinberg who try to put it all together[32] often have little good to say about philosophers, and, indeed, these theories intersect with philosophy only at a remote level.

Yet some philosophy is needed to make sense of the situation that they create. What the physicists confront are bits of experience that function as symbols. Symbols need interpretation. And they refer to the objects *in the interpretations*, not to something beyond them. They are like words. Words have meanings. They are not something above and beyond all their meanings. There is not another 'real word' hidden to the editors of the Oxford English Dictionary. These symbols are, of course, real enough. They are what reality is.

Certainly, one must remind oneself about what this means for ordinary life. What it is to be an automobile is to be a set of experiences which are linked together in law-like ways so that some experiences regularly follow others. If something looks and feels like an automobile and when you lift the hood the bits naturally suggest themselves as the sorts of things that are linked together in the way that the theory of the internal combustion engine applies to them, you expect to find that when you turn the ignition key you will be able to put it in gear and drive away. All that we know about it, of course, can also be interpreted as a set of experiences in the lives of various conscious agents – the driver, the engineer who designed it, the workers who assembled it, and so on. It will turn out that there is nothing that is known about it that did not figure in some way at some time in the experiences or in the interpretative theories of some such agent. One and the same set of presented symbols can be read as a mind at work or as a material object.

The same thing is true, of course, of our brains. It is true, as the materialists say, that every experience has some correlate in the actual or possible experiences of some neurophysiologist who studies brains, though here things get a little stickier. Neurophysiology is inherently a dualistic science, and so not a few of its practitioners over the years have presented themselves as mind–matter dualists. That is, what is seen in your brain has to be correlated with what you experience and say in order to

get a map of what would otherwise only be grey mush. But this is just to say that we need more than one set of experiences to make sense of what goes on in our minds.

When one says that there are rival interpretations of ordinary experiences, one should not be understood to say that there is nothing in any one interpretation which is not in the others. It is true, for instance, that we can rewrite history as the story of atomic particles that have happened from time to time to be parts of human beings. Even at the atomic or sub-atomic level, there will be various theories about these particles, depending, for instance, on whether we think we live in a steady-state Swiss-cheese universe in which our world is a black hole in another world or think that we live in a universe whose earliest limits are given by an original 'big bang'.

But before we perform the reduction of stories about Pharisees and publicans, priests and beggars, politicians and plain-speaking men to stories about atoms, we have to notice that the reduction on anybody's account would miss something. It would be like going to the movies and having a new kind of vision that allowed one to see all the electrons and photons dancing about on the screen, but being unable to 'resolve' them into actors. You would see what was 'going on' on the screen, but you would miss the story.

So, too, in the sciences one option, say the Swiss-cheese steady-state option, contains a lot of material that will not appear in the 'big bang' story, though in this case it is not a matter of missing some experiences – like those of meeting people, falling in love, being deceived by politicians or whatever – but only a matter of foregoing one theory whose scope is rather wider for another, narrower, one.

As to our own involvement with what we know, space and time demand our attention. They can be conceived in any number of ways, but there is a certain arbitrariness in all of them. As Fred Hoyle insisted, there is no present in physics. We provide the present.[33]

There is much talk about time's arrow. It is tied to notions of entropy, which suggest that within adiabatic enclosures the change is always a change toward more disorder. But the physical equations contain no present. We are merely talking about an ordered set of states. The present is still something that we provide. Time's arrow may give us a path through the thicket of data, but we provide the reference point about where we are.

Much has been made of the phenomena of quantum physics. But one hardly needs quantum theory to persuade us that our observations make a difference to reality. Is there anything we can do that does not make a difference to the world? In a profound sense the 'experimental method' has always depended on our ability to make a difference to the world. Perhaps astronomy is among the least invasive of the sciences, and medicine the most. We can look at the sky without changing much, though space probes are another matter. And even looking at the sky through a telescope channels beams of light composed of photons into patterns they would not have had 'naturally'. Certainly medicine changes the patient even when all that is intended is an experiment.

The social sciences focus the problem most obviously, but they also reveal a little more clearly the principle involved. Economists cannot simply describe the world. Their theories influence the way people behave. If the US Federal Reserve Bank raises interest rates in order to slow inflation, people will respond in ways which,

the bank hopes, will make theory come true. Of course people may choose to bet against the bank, but, either way, things will be different. Dr Kinsey's studies of the sex lives of Americans gave people a new idea of what their neighbours were up to, and probably changed some people's behaviour. And Margaret Mead's controversial study of Samoan teen-agers was coloured by the possibility that she prompted her subjects to tell her what she wanted to hear, and then they felt encouraged to behave the way they said they did.

We are inclined to think that there is a condition in which things are naturally, and that what we do brings about changes so that our knowledge is unreliable. Scepticism seems to be the result. In the social sciences we can see at once why this is a misleading notion. There is not something our there called 'the economy' which would go its own way if no one interfered with it. The economists who study it are part of it and their interaction with it is part of the story. One who wants to know how things are likely to go with the American economy must study American economists as much as the steel executives, restaurant owners and stockbrokers who make and market goods and services. Economists are part of it and, in fact, their special interests may be rather significant for its well-being. Sociologists are elements in the societies they study. Anthropologists, one might think, are a little different. They are not part of the Samoan culture, and they do not belong among the Semai whom they study so assiduously. But this is something of an illusion. All human cultures run together and anthropologists are simply part of the communications system. Banning them does not seal off society. You can make the Margaret Meads prohibited immigrants, but American culture will still seep down from the satellites with Mickey Mouse. Until recently, anthropologists have been less concerned to study their own interactions than to study what they took to be primitive peoples, but by now they know better.[34]

One is inclined to insist that there is a 'nature' apart from our investigations, uninfluenced by us. But we are part of nature, and if it were not what it is, we would not be here, either. Nor can we really imagine it without imagining ourselves. We may think of the time when the tiny creatures that have turned into oil romped about in an inland sea where Alberta is now – a time when there were no human beings. But the pictures we draw for children to show their amazement at such a landscape are what people would have seen if people had been there. What was it like with no one to see it? There must have been something there which people would have interpreted in the way that the pictures suggest. And what they would have seen is quite unlike, perhaps, what visiting Martians or three-headed people with quite different senses who arrived from a distant galaxy would have seen.

There was something there to be interpreted. Any full-blooded account, though, involves the interpretations as well as the things to be interpreted. Once again we see that all our investigations show that our accounts of reality are theory-dominant, not because we fail to make the appropriate arrangements for study, but because that is how reality is.

A Basic Picture of the Real

The basic picture, then, is simple enough. The sciences, both natural and social, suggest that reality is the kind of thing that needs interpretation. Our studies of it are theory-dominated. The world is a book to be read and not simply a bunch of hard stuff out there, though stories about the hard stuff out there can be read from it.

Such a world exists objectively in the sense that there really is something to be interpreted. But intelligence is part of its make-up, and it is a pluralistic world that requires more than one mind to give it life.

There is intelligence which is not simply our own subjectivity, but, so far as we know, it is expressed through us.

Notes

1 Wong Yee Toon v. Stump, cited in *Black's Law Dictionary,* 4th ed. revised (St Paul: West, 1968), p. 657.

2 For relevant readings of Eriugena see Terry Eagleton 'The Irish Sublime', *Religion & Literature*, 28/2–3 (1996): 25–36; Dermot Moran*, The Philosophy of John Scottus* [*sic*; Moran's spelling] *Eriugena* (Cambridge: The University Press, 1989). John Milbank, *Word Made Strange* ((Oxford: Blackwell, 1997), p. 101) refers to Eriugena's 'self-referential labyrinth of signs'.

3 See *New Theory of Vision,* Section 147; *Principles of Human Knowledge,* Section 65; *Alciphron or the Minute Philosophers,* Fourth Dialogue, Section 7. *Siris* Sections 251–64 develops this idea in a different way. See also *The New Theory of Vision Vindicated & Explained.* The standard edition of Berkeley's works is edited by A.A. Luce and T.E. Jessop (Edinburgh: Thomas Nelson, 1948–57). Virtually all the many editions have the section numbers. See also G.A. Johnston, *The Development of Berkeley's Philosophy* (London: Macmillan, 1923), pp. 221–2.

4 Occasionally they speak of 'our universe'. One reason might be to distinguish it from other systems which exist but are not effectively or even possibly in communication with us. If, for instance, a black hole were to implode – and this is not impossible, or so some people think – there might be within such a hole a new world. But we could not communicate with it and, even though it is now generally held that black holes leak a little so that the universes if any within them would run down and some particulars escape into 'our universe', it is unlikely that this would provide an effective line of communication. So then we might speak of there being more than one universe, however confusing this may be.

5 Marcus Chown, 'Cycles of Creation', *New Scientist,* No. 2334 (16 March 2002), p. 26.

6 Arthur Stanley Eddington, *The Nature of the Physical World* (Cambridge: The University Press, 1927).

7 James Hopwood Jeans, *The Mysterious Universe* (Cambridge: The University Press, 1930).

8 See Lizzie Susan Stebbing, *Philosophy and the Physicists* (London: Methuen, 1937). Ms Stebbing questions the inferences from physics and metaphysics, but this is an issue I shall come to.

9 *Modern Cosmology and Philosophy*, John Leslie (ed.) (Amherst, NY: Prometheus, 1998).

10 Richard Burdon Haldane, *The Reign of Relativity* (London: John Murray, 1921).

11 And so Grunbaum calls this 'the pseudo-problem of creation'. See his essay in Leslie (ed.), *Modern Cosmology and Philosophy*.

12 *Space, Time and Deity,* 2 vols. (London: Macmillan, 1920).

13 Conwy Lloyd Morgan, *Emergent Evolution* (London: Williams & Norgate, 1922) and *Life, Mind, & Spirit* (London: Williams and Norgate, 1923).

14 *Le Phenomène humain* (Paris: Éditons du Seuil, 1959).

15 *Process and Reality* (Cambridge: The University Press; New York: Macmillan, 1929).

16 John Elof Boodin, *Cosmic Evolution, Outlines of Cosmic Idealism* (New York: Macmillan, 1925).

17 Henri Bergson, *L'Évolution créatrice* (Paris: F. Alcan, 1907).

18 John Leslie, *The End of the World, The Science and Ethics of Human Extinction* (London: Routledge, 1996).

19 See Fodor's review of Dawkins' *Climbing Mount Improbable* in his *In Critical Condition* (Cambridge, MA: MIT Press, 1998), pp. 163–70.

20 Ernst Mayr, *What Evolution Is* (New York: Basic Books, 2001).

21 Roger Harris writes that Quine's 'work leads directly *away* from positivism; it is plainly idealistic in its overall epistemology (albeit a linguistic idealism), while his underlying metaphysics harks back to Leibniz', *Radical Philosophy,* 107 (2001): 59.

22 Menas Kafatos and Robert Nadeau, *The Conscious Universe* (New York: Springer Verlag, 1990), p. 198.

23 Brian Greene, *The Elegant Universe, Hidden Dimensions, and the Quest for the Ultimate Theory* (London: Jonathan Cape, 1999).

24 Greene, *The Elegant Universe,* pp. 320–44, especially p. 344.

25 Greene, *The Elegant Universe*.

26 Roy Harris, *Signs, Language, and Communication* (London: Routledge, 1996), pp. 125–45, 164, 209ff. I take some of my discussion from 'Language and History', a paper Harris presented to the University of London Institute of Historical Studies at a public seminar on 6 December 2001.

27 See D. Terence Langendoen and Paul M. Postal, *The Vastness of Natural Languages* (Oxford: Blackwell, 1985).

28 For an extended discussion, see Michael A. Weinstein, *Unity and Variety in the Philosophy of Samuel Alexander* (West Lafayette, IN: Purdue University Press, 1984). Weinstein claims that Alexander's cosmos is 'tragic' because deity recedes ever into the future. Yet this is the natural consequence of trying to get the infinite into the finite in time (pp. 71–5). Though Weinstein thinks that Alexander took up Spinoza only late in his life, after 1933 (pp. 75–6),

there is a clear sense in which Alexander's system is Spinoza turned on a temporal axis.

29 John Leslie, *Value and Existence* (Oxford: Basil Blackwell, 1979). There are many references in Leslie's *Value and Existence,* and a rather different account is to be found in A.C. Ewing, *Value and Reality* (London: Allen and Unwin; New York: Humanities Press, 1973). My paper 'Values, God, and the Question About Why There is Anything at All', *Journal of Speculative Philosophy,* (New Series) 1/2 (1987): 148–62, seeks to clarify some of the basic issues.

30 Along with the words 'man is a second God' there is an explanation: 'For as God is creator of real entities and natural forms, so man is creator of rational entities and artificial forms.' *(De Beryllo)*. The Latin text reads 'Hominem esse secundum deum.' See Cusa, *Opera Omnia* (Heidelberg edition) (Hamburg: Felix Meiner, 1988), Vol. 11, p. 7. In *De Conjecturis* II, 14, he says that man is 'almost God' – 'homo enim deus est, sed non absolute, quoniam homo, humanus est igitur deus'; see *Opera Omnia* (Heidelberg edition, 1972), Vol. 3, p. 143. The text goes on to talk of humanity as a microcosm of all there is. Hans Staub has used this passage as the centrepiece for reflection in *Les curieux desirs* (Zurich: Droz, 1967), p. 10.

31 Greene, *The Elegant Universe,* pp. 307–308, notes that strings can be approximated to by point particles.

32 Steven Weinberg, *Dreams of a Final Theory* (New York: Pantheon, 1992).

33 Fred Hoyle, *Man in the Universe* (New York: Columbia University Press, 1966), pp. 32ff.

34 See Sir Raymond Firth's last paper, published after his 100th birthday and just a few months before his death, 'The Creative Contribution of Indigenous People to their Ethnography', *Journal of the Polynesian Society*, 110/3 (2001): 241–5.

Chapter 14

Science and Religious Belief Some Conceptual Issues[1]

William Sweet

One thing we do not lack for today are discussions of the relation of religion and science. The number of books, articles, and book reviews that explore this relation at length seems countless – though far too many of these engage the issues in a polemical or intemperate way. One focus of the recent discussion of science and religion concerns accounts of biological origins – what might be called the Evolution versus Intelligent Design (hereafter abbreviated as ID) debate. And while this debate – which seems to have picked up where the Creationism/Evolution exchanges of the 1980s and 1990s left off – is but a very small part of (and is arguably distinct from) the general discussion of science and religion, it is nevertheless instructive for it.[2] First, it is useful in reflecting on how science and religion relate to one another and, second, it may help us to see some of the specific issues that the parties must address, should they wish to debate whether modern science *challenges* religious belief.

What I wish to do here, then, is outline some of the issues raised in the ID debate, and briefly discuss a few problems that arise for both those who defend and those who challenge Intelligent Design. But I will also claim that both sides share certain presuppositions about the character of religious and scientific propositions – and that it is the failure to understand how these propositions differ from one another that has hindered arriving at a resolution of the ID debate. I will argue that if we understand religious and scientific propositions rightly, we can see how to make progress in the discussion of ID and, more broadly, how to address the general issue of the relation of science and religion.

I

Some have argued that, since both religion and science are in the world, both talk about the world, but offer not only distinct but (at least to some extent) competing hypotheses about the world – about its origin, its guiding principles, its growth and development, and so on – and both of them cannot be right. A paradigm example of this view seems to be found in the recent debate concerning evolutionary theory, 'Intelligent Design', and Creationism. (ID is, to be sure, distinct from Creationism, but there is clearly an affinity between the two.)

On the one hand, we have the work of those defending 'Intelligent Design', like William Dembski, Michael Behe, and others.[3] ID theorists focus on the following question: 'How can we "explain the complex, information-rich structures of biology"?'

They answer that 'intelligent causes are necessary ... and that these causes are empirically detectable'.[4]

They offer, then, what they say is a scientific answer – that is, an account of the origin of these biological structures that is based on observation, the use of a careful method of analysis and investigation, a determination of what had to be the case in nature for this complexity to arise or exist, and arguments for what the best explanation for these complex structures might be. Thus, these advocates conclude, ID is at least a plausible, if not the best, explanatory hypothesis for the complexity and order we find in the biological world. And they say that a refusal to take ID seriously is not really based on scientific grounds, but on prejudice – and, specifically, anti-religious prejudice or atheism.

On the other hand – and, in part, in response to ID – we have recent volumes by Richard Dawkins, Daniel Dennett, Robert Pennock, and others.[5] Claiming to be following in the footsteps of Darwin, these accounts presuppose materialistic, naturalistic, and (often) reductionistic accounts of reality – accounts that differ, but which all seem to hold that what exists is only contingently so, that there is no reason to believe that the characteristics of complex structures have anything but a naturalistic explanation, and that there is no evidence of purpose in the (biological) world being as it is – which clearly exclude explanatory hypotheses of intelligence or design.

Now the claim of these evolutionary theorists is that whatever it is that is to be explained – the existence of life, the characteristics of different species, consciousness, and so on – does not require us to look for anything outside of nature. In fact, these authors go further; they insist that there is simply no room for an appeal to the non-natural or the divine. As one proponent puts it: 'Whether pushing us or pulling us toward his desired end, the Christian God [and the Jewish and Muslim God as well, presumably] is utterly extraneous to evolution as Darwin and his modern successors have understood it. Evolution is an undirected, reactive process ... or it is nothing at all.'[6]

When it comes to their views on ID arguments – which (it is claimed) not only allow for, but insist on, a non-natural explanation – Dawkins, Dennett, and others make three basic claims. First, they argue that ID is *not* a *plausible* hypothesis – either that the alleged evidence for ID is not sufficient (or can be reasonably accounted for by a naturalistic evolutionary hypothesis or a similar naturalistic explanation) or that the 'scientific' evidence on which it is based is simply erroneous. Second, such critics frequently claim that ID is *not* a genuinely *scientific* hypothesis – that it doesn't offer any experimental method for testing its truth, it isn't predictive, *and* it doesn't provide a clear explanation of all of the data to be explained. And, finally, these critics of ID maintain, any conclusions we might want to derive from ID – say, conclusions about the existence and characteristics of a supernatural intelligence – are *unnecessary* hypotheses; that we 'have no need for that hypothesis'.[7]

What is presupposed here – by both camps – is that ID and evolutionary theory are (as noted earlier) competing hypotheses. They are 'on a par' and, in the form presented in the preceding paragraphs, they both cannot be true. Critics will argue that since ID fails as a hypothesis, the best account of what needs to be explained (that is, biological complexity) is that provided by evolutionary theory. ID theorists will argue that evolutionary theory fails to provide a (statistically) plausible account

of the phenomena, and so we have to allow for non-natural elements or a non-natural explanation.

There are several comments that should be made here.

First, and most obviously, this debate has often been presented as a conflict between a 'pure, neutral' science and a 'religiously influenced' science (if not religious beliefs masquerading as scientific hypotheses). But one should see that there very well may *not* be any conflict of this kind, here. For example, the definition of 'evolution' given above – that it 'is an undirected, reactive process ... or it is nothing at all' – is a stipulative one, and one of which we are told: 'Take it or forget about evolution altogether.' But what 'evolution' is, is *not* so simple – as the history of the term readily reveals. The phenomena described by the term 'evolution' have been, and can be, understood as illustrating gradual or even periodic accelerated (punctuated?) development, *without* the additional claim that such change is 'undirected' or entirely 'reactive'. And so, even before we start talking about putative conflicts between science and religion, or conflicts between different kinds of science, we have to be sure that the terms of the discussion themselves do not beg any relevant questions.

Second, at least some of the above objections to ID theorists – for example, that they are not providing genuinely scientific hypotheses – are misplaced. It may well be that ID is not a theory in the way in which evolution is a theory (or, to be more precise, a set of theories). But we have to distinguish between 'hypotheses' and 'theories'.

By 'hypothesis', I mean 'a suggestion or conditional explanation that may be used as a guiding norm and that is capable of confirmation, verification, or disproof by subsequent evidence.'[8] By 'theory', I mean 'a hypothesis or set of hypotheses that provides at least a provisional explanation of a phenomenon, along with procedures and rules that give the mechanics of the explanation, specify how to verify or refute the hypothesis, and that make predictions concerning future occurrences of the phenomenon, along with providing criteria to test the reliability of these predictions.' A theory, then, is a hypothesis that has been elaborated, applied, tested, and found useful for guiding research in the future.

'Naturalistic evolution', then, is both a theory and a hypothesis concerning, among other things, the origins of species; ID is a hypothesis about species origin, though it may not be a theory (for example, doesn't predict, doesn't give the mechanics of the explanation). But this doesn't make ID non-scientific. We have hypotheses in the natural sciences, such as biology, but also in the social sciences, such as anthropology, archaeology, psychology, and so on. Some of these hypotheses may lead to theories; others may not. One need not deny, then, that despite the differences between them, evolution and ID *can* be competing hypotheses.

Is ID a plausible hypothesis? Whether ID is plausible – whether it provides a good or 'the best' explanation – is something that presumably must be decided on scientific grounds (for example, how far it is successful in accounting for the phenomena to be explained; what evidence would confirm it or would tend to disconfirm it). Now it may well be that ID does not offer much of an explanation – that it not only isn't testable or repeatable, but doesn't provide much, if any, of the mechanics of how things came about (for example, that God intervened at point X, or that God set things up such that, at point X, phenomenon Y would result, and so on).

And it may not offer much of a theory, or *show* how we might corroborate the claims it makes. So it may be a scientific hypothesis, but not a strong one, and not a theory at all. Nevertheless, one thing should be emphasized: the 'conflict' between ID and naturalistic evolution need not be (and as ID's defenders insist, *is not* to be) understood as *religion* and science offering competing hypotheses. Even though it may be true that ID has been articulated and defended by religious believers, that the inspiration for it was based on a prior conviction which was fundamentally religious, and that religious denominations champion it, to accuse ID of being a 'religious belief' or a 'religious' account is to commit the genetic fallacy. In other words, ID is *not* a religious belief, even though religious believers may believe it, and even though its conclusion or guiding hypothesis may resemble what *is* plausibly a religious belief – namely that 'God created and designed biologically complex organisms.'

For it to be what it claims to be, then, ID must propose a scientific hypothesis, and the discussion of ID should take place at the level of science; accusations of atheism or of religious belief should not enter the debate. This does not mean that ID cannot be challenged or shown not to be as comprehensive a theory as evolution. But such challenges must take place in the scientific arena, and not be ad hominem or other kinds of personal attack.

Still, it might be possible to extend the conclusion of ID – that there is a purposive, intelligent designer of the universe – to prove religious beliefs. If ID arguments are successful, do they prove that there was a creation? Do they prove that there is, or could be, a God who created and designed the biological organisms in the universe? In other words, can ID *as science* prove, or give us good reason to believe, a religious belief? As just noted, it may seem that the proposition 'There is a God who created and designed the biological organisms in the universe' is just a slightly more explicit version of the conclusion of ID (that is, that there is a purposive, intelligent designer); that ID, as science, can in principle establish a religious belief; and that, just as evolutionary science and ID science compete, so also do the claims that (on the one hand) 'The universe always existed without any intelligent design' or 'The explanation of apparent design in living beings is that of a process of evolution driven by natural selection', and (on the other) 'The complexity of biological organisms is the product of direct design by a Creator God.' And if *this* is so, then not only might one suggest that there could be a complementarity between science and religion,[9] but one could hold that a scientific explanation and religious belief here *are* commensurable, if not on a par, and that the former can provide evidence for the latter.

I would argue that such inferences go too far – that such an approach misconstrues the relation between science and religion, and that ID cannot – and ought not attempt to – make or defend religious claims, even though there is plausibly some relation between the conclusions of ID and of religious belief. I would insist that there is a fundamental epistemological difference between a religious belief and a proposition or conclusion of 'science' – that science and religion are not offering competing hypotheses, and that believers should not expect too much, even if ID arguments were to prove to be successful. Nevertheless, the affinities between the conclusions of ID and religious belief can give us some clues about a much more fundamental and, arguably, more interesting question – and that is, how science and religion are related.

But to defend the preceding claims, I have to clarify some concepts. Specifically, I need to explain what religious belief is, what makes a proposition or hypothesis a *scientific* hypothesis, and in what ways religious beliefs might be related to propositions expressing scientific hypotheses.

II

What is a religious belief? What makes religious belief *distinctively* religious? In earlier papers and books,[10] I have given what one might call a phenomenological description of religious belief. On this view, religious belief is not just (or even primarily) about some other world, but about *this* world; indeed, it is a *response* to what the believer encounters in the world.[11] What makes a religious belief distinctively religious is not (just) that it refers, directly or indirectly, to certain persons (such as Jesus, or YHWH) or events (such as the virgin birth or the appointment by Muhammad of Ali), but that it i) has an expressive role or function in a person's life, ii) indicates one's disposition or intention to act in a certain way, that is tied to a particular set of practices (for example, a language, prayer, worship), and iii) be such that the persons or events referred to (are claimed by the speaker to) have a relation to a reality which is not restricted to the empirical, observable, and material. In other words, what makes a religious belief religious is not just its subject matter – that is, that it is a belief about certain beings or events – nor is it just that it is held in a certain way – that is, in a way that expresses a trust or commitment that shows that the beliefs are fundamental to how one leads one's life. It is the holding of a set of beliefs in this *latter* way that makes them religious.[12]

On this account, a religious belief has both descriptive and dispositional elements; nevertheless (as I have argued elsewhere[13]), the presence of this dispositional element need *not* prevent us from speaking of religious beliefs as true. Nor does religious belief have conditions for 'truth' that are unique to it. We can speak of religious beliefs as 'true', then, when they meet general standards for *all* truth claims (in the sciences, morality, and so on). These conditions are that i) they are not self-contradictory or inconsistent, ii) that they meet standards for being known to be true set by not just the practices, but the traditions and institutions in which they are made,[14] iii) that they are consistent or coherent with other true beliefs (for example, moral and empirical ones) in other discourses and practices, and iv) that they reflect 'what is' – including the dominant ideas in human consciousness.[15] The meaning and truth of particular religious beliefs are *initially* determined within a religious discourse or tradition (for example, as being coherent or incoherent with other beliefs in that discourse or tradition), but they must ultimately be consistent with other beliefs (for example, moral beliefs) and meet standards (for example, epistemic standards) that exist independently of that discourse or tradition. And since religious belief is a *response* to the world, and because (as I claim) individual religious beliefs have a cognitive and descriptive dimension, there must be commensurability between religious beliefs and other beliefs, and even some kind of commensurability between one religious tradition and another.[16]

I would make parallel – and, as appropriate, contrasting – claims about propositions that express scientific hypotheses. What makes a scientific proposition *distinctively* scientific? Again, to begin with, scientific propositions are generally either empirical propositions or have a place within a broader scientific practice or theory, or both. The function of a scientific proposition is normally to describe – either particular matters of fact (for example, persons, events) or the way in which matters of fact exist (as we might when we articulate a 'scientific law').

In principle, a scientific proposition is a proposition that purports to be publicly testable – that is, there normally are generally agreed-on procedures for how we would determine whether what it states is true. Of course, it must meet the usual standards of meaningfulness – that it is not self-contradictory or gibberish, that it generally affirms or denies something, and so on. More substantively – and in the sense in which we would usually understand the term – scientific propositions must meet the various conditions or general standards for truth enumerated above. Moreover, these propositions are said to be neutral – that is, they generally don't require that one ascribe a particular value or importance to them. Here, I would take, as examples, such propositions as: 'The surname of the mayor of Chennai, India, on 15 August, 2002, was "Stalin"' or the formula in physics for velocity (that is, 'Average Velocity is equal to Distance divided by Time' – 'v = d/t'). To this, a critic might object that there *cannot* be neutrality here – that one who knows or utters these propositions values the kind of enterprise in which such propositions have a place. But I would disagree.

The values or attitudes of one who presents a scientific hypothesis are not essential to the *meaning* of that proposition. To put it slightly differently, it normally doesn't matter *who* utters these propositions; the meaning remains the same. And once we know what a particular scientific proposition means, its truth value as well is independent of the attitudes or values of the speaker. (In fact, it may not even matter to the person expressing such propositions whether these propositions are true – except so far as one wants to hold propositions that are true.)

It also normally doesn't matter what ethical, metaphysical, or religious beliefs are held by the person who tests a scientific proposition or hypothesis. By itself, the meaning or truth of such a proposition doesn't require or imply any particular fundamental ethical, metaphysical, or religious commitment. And nothing value-oriented specifically follows from it either. And so – rightly or wrongly, and unlike religious or ethical or aesthetic beliefs – scientific propositions are generally held to possess 'objectivity'.[17]

(Some might say that a scientific proposition *can* have a dispositional element – for one may seek to act on the propositions one holds. But unlike the case of religious belief, this dispositional element is not an essential part of what the particular proposition means and is therefore not relevant to whether it is true. And while meaning, in both religious belief and scientific investigations, is determined within a set of practices – for example, within a discourse – still, it isn't clear that scientific practices reflect trusts or commitments or beliefs that are fundamental to one's life, or that they are necessarily expressive, or that they necessarily indicate one's disposition or intention to act in a certain way.)

It is this character of 'public' testability, of neutrality, of 'utility', and of objectivity that seems to characterize (most) scientific propositions and that no doubt explains the appeal of seeking and giving a scientific explanation of events. (Presumably, on this view, there is no room for any subjectivity that might 'taint' claims to universality or truth.)

It is clear from the preceding descriptions that religious beliefs and propositions expressing empirical claims or scientific hypotheses are distinct – for example, whether the proposition has a genuine and a demonstrable place (such as having an expressive role or function) in the life of the person who holds it; whether the proposition indicates one's disposition or intention to act in a certain way; concerning what sorts of events or objects or practices the proposition presumably refers to; about the extent to which the personal stance of those who hear it or are in a position to evaluate it is relevant to its meaning and truth; and so on.

But they are *not radically distinct* from one another. For, as we have seen above, and as we see in looking at religious practice, religious beliefs are *in* the world – the same world in which scientific hypotheses are proposed and empirical claims are made; they are often a response to experiences or events that are said to have taken place in the world; they profess to tell us certain things about the world (perhaps, things that we could not otherwise know or discover)[18]; they commend us to act in certain ways in *this* world, and so on. And, as noted above, for a religious belief to be true, it must meet at least some core criteria that scientific propositions must also meet in order for one to understand their meaning and to determine their truth. So it is inevitable that religion and science will affect one another and have a relation. But what exactly this relation is, is a question I want to defer for a moment. Instead, I want first to ask: 'what is the consequence of this account of religious belief and of science for the ID debate and, more broadly, for our understanding of "truth" in science and religion?'

III

Earlier, I discussed the question of whether ID theorists are employing a genuinely scientific approach. For, if the debate concerning ID is to be scientific, then the hypotheses or conclusions of ID have to fit the model of scientific propositions, described above. What this means, for example, is that when ID theorists present a hypothesis or make claims, what they say would have to be broadly consistent with a larger set of scientific theories and the standards appropriate to them. Such a hypothesis would describe a matter of fact (for example, complexity in phenomena) and, say, provide a causal account of it. One would also expect that such hypotheses or conclusions could be adopted by all scientists, regardless (or independently?) of their (prior) commitments to a particular set of values or metaphysical or religious commitments. (In other words, if ID theory is scientific, then one's religious or ethical views should be irrelevant to one's discussion and assessment of it.) Adopting such hypotheses need not lead one to any particular values or to make any broad commitments based on them.

Of course, for the hypotheses or conclusions of ID to be taken seriously, the evidence for them would have to be that they are not only possible, but probable or plausible – that there is, in other words, corroborating evidence that suggests the chances of ID being true are at least roughly the same as or greater than the chances of other hypotheses being true. One hypothesis of the origin of the universe, difficult to *refute*, is that the universe came into existence exactly 5 minutes ago, and that all of us have false 'memories' of whatever we think happened more than 5 minutes before. But the evidence *for* this is slim, to say the least, and other hypotheses seem (non-circularly) to be more probable. It may well be that we cannot actually calculate this degree of probability except in a very rough way, but this does not preclude us from saying that some hypotheses are more probable and also more plausible than others – for example, it is more probable that I am here, writing in my office, than that I am at home, asleep in my bed.

So, if ID *avoids* conclusions that are clearly religious beliefs (for example, claiming that the source of ID is the being that believers call God or that it establishes a particular metaphysical claim about such a being's existence, and that, as a result, one must intend to act in certain ways or engage in a certain set of religious practices), then while one may fault ID for the quality of its science, it is a red herring to raise issues about the kind of people who believe it, or what inspires them to pursue such investigation, and so on.

Still, ID as science would be consistent with – and perhaps lend some psychological support to or even corroborate – *religious* belief about the origins of life (for example, that it was created by God). It is not, however, able to demonstrate such belief. Thus, while scientific hypotheses and religious beliefs are distinct from one another, the fact that the conclusions of ID science are claims made about the same world that religious believers also wish to talk about, shows that science and religion must have a relation to one another.[19]

This illustration of how ID science can bear on religious belief also gives us some indication of how to respond to the question of how we can talk of religious beliefs as true or false.

As we have seen above, in both science and religion, 'truth' is something that can be determined only after we have understood what a proposition means. Here, the burden is both on the person expressing the proposition to make the belief clear, and on the 'listener' to be willing to try to understand what it means in the context in which it is expressed. Thus, listeners may need to make an effort to understand the believer's discourse or background beliefs before being confident that they can say what a *specific* belief means, or whether the belief means anything which they could affirm or deny. Discerning the meaning from within the context isn't enough. To begin with, propositions expressing religious beliefs (as with all propositions) must meet general criteria for meaningfulness. This is in part determined internally to a particular set of practices or discourse, but, as we have seen, must also respect general regulatory principles of all discourse. But to determine meaning one must consider as well what other claims or beliefs this particular belief involves – and we can see this by looking at the role of that belief in the believer's life, but also what the believer takes to follow from it, and how the intention or disposition to act on it is carried out.

Once meaning is at least reasonably clear – that is, that one can confidently say that one understands what is being said – then one is in a position to determine whether the belief or claim meets the general conditions for truth outlined above. Is it internally consistent? Does it meet the accepted standards for truth in that context? And, most importantly, how does it fit with, and is it consistent with, other true beliefs? and so on. Thus, suppose that one wished to find out whether a religious belief – say, a claim that a miraculous event occurred – is true. First, one would enquire whether there is any a priori problem with what is claimed. Does it affirm something that is logically incoherent? (Apparent inconsistency with past experience or with laws of physics would not be sufficient to establish logical incoherence.) Then one would look to see whether it meets criteria for being known to be true – for example, whether it is based on the kinds of observation or testimony (particularly from an authority) that have been reliable in the past. One would also need to ask how it fits with other (empirical, moral, and so on) beliefs and with how the world is. And then, finally, we would ask whether other beliefs that are involved with the one under consideration also satisfy the preceding requirements. (Satisfying these conditions does not mean that the belief is true only in a context; rather it reminds us that the way that one can show a belief to be true varies according to the object of the belief.)

With this, then, we can return to the question I deferred a moment ago.

IV

What does the preceding account of religious belief and science suggest about the relation between science and religion? First, from what we have seen, I think it is clear that scientific propositions – those propositions that can be known through the use of scientific method – do bear on religion and religious belief. But precisely how they do so needs to be explained.

Recall what was said earlier concerning the cognitive or descriptive dimension of religious beliefs. Religious beliefs (or propositions expressing religious belief) must 'fit' (that is, not contradict, and at least to some extent cohere) with what is known empirically, morally, and so on (that is, with other true propositions or with their implicates). (These 'implicates' need not be just propositions analytically implied; they could be propositions *strongly suggested* by other propositions. In this sense, 'Jesus is the son of Mary' implies that Jesus was human.)

Now, if such beliefs *don't* obviously fit with other beliefs that we claim to know to be true, then we may have to re-examine them all – that is, go back and reconsider whether we have correctly understood what the relevant (religious and non-religious) beliefs mean. In the end, we may have to revise or abandon some of our prior beliefs. What this entails is that what is known through science can legitimately oblige religious believers to be clear about what they mean or what they are committed to (for example, the results of scientific investigation may get them to reassess whether what they believe really is a religious belief, or whether they have the right to hold it as a *religious* belief). For example, it can reasonably require a person to state whether a six-day creation or Jesus changing water into wine is a *religious* belief

– or scientific (that is, just about events in the world, implying no special trust in or commitment to their truth). But regardless of whether such claims are religious or scientific, they have to meet the conditions of meaning and truth described above. And the reverse is true as well; religion may force people to consider what, exactly, their scientific views are, and whether a particular claim is not a disguised – or does not presuppose some – ideological or philosophical view (for example, the view that only what is material is real).[20]

Once one is reasonably clear about the nature and content of one's religious beliefs, what more can be said about their relation to science?

Science cannot prove *religious* beliefs. At most, an investigation carried out within the methodological parameters of the sciences can 'confirm' an element of religious belief – it can never completely establish it. Consider, for example, an event such as the crucifixion of Jesus. We could imagine that a historian or an archaeologist might be able to find evidence that could prove that someone named Jesus – who was the leader of a small group, who preached a message of love and repentance throughout Judaea, Galilee, and Samaria, and so on – was crucified in the 30s CE on the very site that is today in the Church of the Holy Sepulchre in Jerusalem. Still, that would still not prove the *religious* belief that Jesus – the Christ, the Messiah, whose coming was prophesized in the Hebrew Scriptures, and so on – was crucified. Nor could it show that an appropriate response to Jesus' crucifixion is to accept Jesus as Lord, to thank or praise Jesus' name, to engage in certain religious practices, and so on.

Science or scientific method may, however, be able to *challenge indirectly* some beliefs held as religious by believers – at least in the sense that it might be able to show that something which the religious belief presupposes or entails is simply false. Because religious belief can involve claims about the world, empirical evidence is relevant, just as it is relevant to scientific hypotheses. Thus, if it could be proved that there was no man named Lazarus – brother of Mary and Martha, living in Bethany, near Jerusalem, around 30 CE – then it can't be true that Jesus raised Lazarus from the dead[21], although even this does not exclude the possibility that Jesus might have raised *someone* from the dead, and so on.

Of course, some religious beliefs make descriptive or cognitive claims that are not able to be refuted by science. That Jesus was conceived without the agency of a human father is, for many, a religious belief – and yet even our extensive knowledge of human biology does not provide conclusive evidence against it. (Of course, if science found that such a conception *could* happen, it wouldn't mean that a *religious* belief had been proven.)

Finally, we must recognize that, concerning some beliefs – for example, that God is three persons in one – science can have nothing to say. But this is for the same reason that we must allow that, for some scientific claims – for example, that the smallest particle of matter will be discovered to be the 'newton' – religion can have nothing to say. It is simply beyond its purview. If, as the saying attributed to Galileo runs, 'The Bible tells us how to go to heaven, but not how the heavens go,' why think that knowing how the heavens go need tell us everything about how to get there?

If a religious belief does not fit – that is, is incoherent, or inconsistent, or incompatible – with what science tells us, what are our options? Either we must admit that the belief is 'not true' (though it is not necessarily false), or say that it

may not be a genuine religious belief, or maintain that it may be 'true', but in some larger, non-propositional, non-cognitive sense of 'true' (such as when we talk about 'truth' in art).

In short, then, scientific propositions bear on religion and religious beliefs. And we can say that science can sometimes help in an assessment of the meaning and truth of certain religious beliefs. (As noted above, in some cases the results of scientific investigation may challenge the grounds of these beliefs; in other cases, they may call on believers to reconsider what, exactly, their beliefs mean; and so on.)

But we should also remember that the relation between science and religion is not one-sided. And so, just as science can bear on religion, religion can bear on science. For example, religion can serve as a guide for science. Some religious beliefs may indicate – at least for those who hold them – that certain courses of scientific investigation are dead ends – for example, investigations that propose to provide a purely materialist account of consciousness, or that deny the existence of consciousness entirely. And religious beliefs – and these need not be *one's own* religious beliefs – may recommend that a person direct his or her scientific enquiries to fields that are socially responsible or do not violate human dignity, or into areas that improve the well-being of the community (for example, concerning the value of nature). More generally, religion may lead one to 'press a point'– for example, that scientists (or philosophers) cannot merely assert that explanations of phenomena or events must always be naturalistic in character – though here the point is philosophical rather than scientific.

Moreover, religion *can* challenge or judge science. For example, in a 1997 statement concerning evolutionary theory, made in an address to the Pontifical Academy of Sciences, Pope John Paul II said: 'theories of evolution which, in accordance with the philosophies inspiring them, consider the mind as emerging from the forces of living matter, or as a mere epiphenomenon of this matter, are incompatible with the truth about man'[22] – and are, presumably, therefore false. (Whether such a statement is true does not need to be determined in order to see that, *if* it is true, it would challenge these theories.) In this way, then, religious claims can challenge scientific claims (or principles). Nevertheless, it does not challenge it from within science, that is, not qua a scientific claim; a religion or a theology cannot show or demonstrate that a (genuinely) scientific proposition is false. To be able to show this, it would have to be part, and subject to the principles, of science – and thus cease being religion altogether.

We can say, then, that religion bears on science just as science bears on religion, and that – from the examples given above, and the general acknowledgement that meaning and truth both involve the coherence of beliefs – challenges to scientific propositions by religion cannot be automatically ignored.

Science and religion are, clearly, related. The results of scientific enquiry may confirm or corroborate the descriptive element of religious belief, though they cannot prove the belief itself. Such results may also challenge a belief – so that one may have to reassess what, exactly, the relevant scientific beliefs and religious beliefs mean – and may even lead one to reject that belief. Conversely, religious belief may guide scientific practice, or gauge its utility or fruitfulness, or may even challenge particular claims. But it cannot directly disprove a scientific proposition.

Like morality, religion includes meaningful and true statements about the world – statements that cannot be known through the methods of the sciences. But this does not mean that there is no connection of religion with science. And this is why neither a fideist approach (which radically separates the two) nor a strict empiricist approach (which tries to reduce religion to science) succeed in understanding the relation of science and religion.

V

I have argued here that an analysis of the presuppositions of the Evolution versus Intelligent Design debate reveals that to object to ID on the ground that it provides a religious hypothesis, or is religion disguised as science, or on similar grounds, is mistaken – that such accusations are a red herring.

What is at stake in the present discussion is, however, larger than the Evolution versus ID debate; it concerns the general issue of the relation of science and religion. I have maintained that there *is* a relation between science and religion. As noted above, because of the descriptive element in religious belief, empirical evidence is relevant, just as it is to scientific hypotheses and claims. This relation is one that can be supportive, where science may confirm or corroborate the direct or implied *descriptive* element of religious belief – though it cannot prove religious belief. Or it can be critical when, for example, it challenges (the descriptive dimension) of a religious belief, and forces one to reconsider what that belief means. (Of course, challenges to religious belief might also come from other, non-scientific realms as well – for example, morality and aesthetics.) Nevertheless, even when there are challenges to or allegations of meaninglessness or of the falsehood of a religious belief, these challenges may be only temporary – for example, so far as the empirical data that are part of the belief are in fact reliable.

Religious belief *as a whole* – what is sometimes called 'faith' – is not, however, subject to scientific investigation or its methods. This is at least in part because religious beliefs are independent of science in the way in which moral propositions, the propositions of ideologies, aesthetic propositions, and so on, are independent of science.[23] Moral theory, political theory, aesthetics, and the like are, in this sense, 'non-science', but this is not to say that are 'nonsense'. Their respective subject matters *are* subject to criteria for meaningfulness and truth, and include the kinds of beliefs that are held by beings we recognize to be reasonable.

There is a correlative relation between religion and science. It is not that religion confirms or corroborates the results of science, but that religious beliefs may contain descriptive and prescriptive claims that can guide or suggest options that those engaging in scientific research should consider. Some of these claims may present a different way of looking at the world from that which scientists adopt qua scientists, but which nevertheless bear on how they carry out their research. And some may be normative principles which could serve to guide or be used to assess the value or morality of scientific research. (This is similar to the way in which other 'non-sciences' – such as justice and morality – may challenge or guide or be said to assess science – for example, a scientific practice.) But, as noted above, a religion or a

theology as such is not in a position to disprove a scientific proposition. In general, the propositions of religion and science, so far as they are true, must 'fit together' – they must cohere.[24] While they are not of the same character, and while they do not directly imply one another, these propositions can clearly be related to one another. Nevertheless, how they are seems to be something that has to be determined on a one-by-one examination of the relevant propositions; it does not seem to be able to be articulated in a general formula.

We cannot deny the relevance of the results of the enquiries of the sciences to religious belief. For in learning what science can tell us, we understand more of the world in which religion has a place. Yet this does not mean that we have to adopt 'a strictly scientific humanism'[25] that reduces religion to a set of empirical hypotheses. In understanding what is true in and about the world, there needs to be room for propositions of both science and 'non-science' – for example, religious belief, aesthetics, morality, politics, and so on – and a positive and genuine relation among them. The right relation between science and religion, then, is one that acknowledges that each bears on the other, without presuming the reducibility of one to the other. For, most importantly, the practice of religious belief and the practice of science must both be subordinate to truth.

Notes

1 This is a modified version of my 2002 Presidential Address to the Canadian Society of Christian Philosophers, in Toronto, Canada, and of papers presented at the Madras Christian College later that year (and first published in Varghese Manimala (ed.), *Faith, Reason, Science* (Delhi: Media House, 2003)). I am grateful to those in attendance, and particularly D. Goldstick, K. Kraay, and J. Kalapati, for their comments.

2 The ID debate has been intensely polarized and polarizing. Criticisms often focus on tangential matters, and those who defend it sometimes claim too much or commit themselves to claims for which evidence is lacking. Still, it provides a useful illustration for a discussion of the relation of science and religion.

3 See, for example, Michael J. Behe, *Darwin's Black Box: The Biochemical Challenge to Evolution* (New York: Free Press, 1996); *Mere Creation: Science, Faith and Intelligent Design*, William A. Dembski (ed.) (Downers Grove, IL: InterVarsity Press, 1998); William Dembski, *Intelligent Design: The Bridge Between Science and Theology* (Downers Grove, IL: InterVarsity Press, 1999) and *The Design Inference: Eliminating Chance through Small Probabilities* (Cambridge; New York: Cambridge University Press, 1998); Phillip E. Johnson, *The Wedge of Truth: Splitting the Foundations of Naturalism* (Downers Grove, IL: InterVarsity Press, 2000); and Jonathan Wells, *Icons of Evolution: Science or Myth? Why Much of What We Teach About Evolution Is Wrong* (Washington, DC: Regnery, 2000).

4 Access Research Network, 'Frequently Asked Questions about Intelligent Design' http://www.arn.org/id_faq.htm

5 See, for example, Richard Dawkins, *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design* (New York: Norton, 1986; revised edition; 1996); Daniel C. Dennett, *Darwin's Dangerous Idea: Evolution and the Meanings of Life* (New York: Simon & Schuster, 1995); Robert T. Pennock, *Tower of Babel: The Evidence Against the New Creationism* (Cambridge, MA: Bradford/MIT Press, 1999). A hyperbolic defense of these views, principally at the level of ad hominem, is Frederick C. Crews, 'Saving Us from Darwin', *The New York Review of Books*, 4 October and 18 October 2001.

6 See Crews, 'Saving Us from Darwin', 18 October 2001.

7 This remark is attributed to Pierre Simon Laplace, French mathematician and author of the five-volume book, *Celestial Mechanics*. When presented with a copy, Napoleon allegedly commented, 'I see no mention of God in this work.' Laplace is reputed to have replied, 'Sir, I have no need of that hypothesis.'

8 Cf. the definition of 'hypothesis' found in Dagobert D. Runes, *A Dictionary of Philosophy* (Totowa, NJ: Littlefield, Adams, 1962), p. 134.

9 Attempts to find common ground – because of the 'incompleteness' of science in providing a comprehensive explanation of reality – take a wide range of forms. See *Darwin: A Norton Critical Edition*, Philip Appleman (ed.) (New York: Norton, 3rd ed., 2001), pp. 525–33, 613–23. For some of the recent discussion, see Kenneth R. Miller, *Finding Darwin's God: A Scientist's Search for Common Ground Between God and Evolution* (New York: Cliff Street Books/HarperCollins, 1999); Robert Pollack, *The Faith of Biology and the Biology of Faith: Order, Meaning, and Free Will in Modern Medical Science* (New York: Columbia University Press, 2000); John F. Haught, *God After Darwin: A Theology of Evolution* (Boulder, CO: Westview Press, 2000); Michael Ruse, *Can a Darwinian Be a Christian? The Relationship Between Science and Religion* (Cambridge; New York: Cambridge University Press, 2001); Stephen Jay Gould, *Rocks of Ages: Science and Religion in the Fullness of Life* (New York: Ballantine, 1999).

10 See, for example, my 'Discourse and the Possibility of Religious Truth', in *Sophia*, 37/1 (1998): 72–102 and my *Religious Belief: The Contemporary Debate* (Bangalore: Dharmaram Publications, 2003).

11 Here I draw, almost verbatim, from the account I give in my *Religious Belief: The Contemporary Debate*, pp. 133–4.

12 As an illustration of how the beliefs one holds makes a difference to the meaning of a particular belief, think of how a Muslim's denial that 'Jesus is God' differs from an atheist's.

13 See my 'Discourse and the Possibility of Religious Truth', especially pp. 87–91. In this paragraph I draw again on my *Religious Belief: the Contemporary Debate*, pp. 145–6.

14 For example, the claim that the consecrated bread of the Eucharist is the body and blood of Christ is not just 'true' in the 'practice' of communion, but is part of the Christian tradition and – some theologians would say – true regardless of the practices around it.

15 One of the ideas that seems to be dominant in human consciousness is the concept of person. Of course, there are disagreements about what exactly the term 'person' means and what it refers to – but it is clearly an idea that has a place in a wide range of religious, moral, and empirical beliefs, and one that may serve as a control or check on the other beliefs we may think to be true.

16 This is compatible with John Hick's views on pluralism.

17 Since the meaning and truth of scientific propositions do not seem to depend on one's metaphysical or ethical or religious beliefs, and since they clearly touch on even the most mundane aspects of daily life, they may be 'used' by everyone – i.e., they have a general utility or practicality – and they may be considered by many to have a greater utility or usefulness than religious or ethical beliefs.

18 That a religious belief might tell us something we wouldn't otherwise know does not make what we come to know a religious belief.

19 A critic might, following R.G. Collingwood, say that two people may see the same world very differently; Collingwood gives the example of an artist and a scientist observing a sunset:

'Everybody knows that there is one frame of mind in which one regards an object scientifically, and another in which one regards it aesthetically. … But the aesthetic and the scientific attitudes are not merely different attitudes towards the same object, namely a sunset. The object is different. The scientist 'sees' in the sunset a concrete embodiment of certain scientific laws; the artist 'sees' in it a harmonious pattern of colours.' (*Speculum Mentis*, Oxford: Clarendon Press, 1924, p. 62).

But this goes too far. It is true that not all the statements each makes about the sunset bears (immediately) on the other's. Yet both are talking about the same thing – the sunset – and the *properties* seen by one person (e.g., the scientist) may clearly bear on the *properties* seen by the other (e.g., the artist).

20 In this sense, just as one might ask whether 'creationism' or ID is a scientific view, one can also ask whether certain formulations of evolutionary theory are scientific. For some may hold to evolutionary science, not as a theory open to verification and, in principle, to disproof, but as an ideological view – to which they may be committed beyond, or without, evidence.

21 See John 11.

22 John Paul II, 'Message to the Pontifical Academy of Sciences', reprinted in 'The Pope's Message on Evolution and Four Commentaries', *The Quarterly Review of Biology*, 72/4 (1997): 382–3.

23 This statement of the relation of science to religion presumes, of course, that science has – and works within – its proper sphere. This is something that cannot be determined by science itself, but by philosophy – a *philosophy* of nature, as Jacques Maritain would have it. Cf. *The Degrees of Knowledge, or Distinguish to Unite*, Gerald P. Phelan (ed.) (Notre Dame: University of Notre Dame Press, 1995), Ch. 4, Section 2: 'The Philosophy of Nature', pp. 184ff. On Maritain's view, scientific claims are only about the objects of science, and scientists can make no claim, and certainly no claim about the provability or unprovability – positive or negative – of the existence or character of

anything that is not the object of science. A 'philosopher of nature', however, is able to go beyond the scientist – not by being able to provide the proof of such a thing, but by determining what the conditions for such a proof must be like.

24 It should be clear from the preceding that I am not proposing the recent quasi-scientific view of religion of Michael Ruse (where certain claims, often held to be religious beliefs, are given purely naturalistic explanations). See Michael Ruse, *Can a Darwinian Be a Christian? The Relationship Between Science and Religion*.

25 Sarvepalli Radhakrishnan, 'Science and Religion', in K. Bharatha Iyer (ed.), *Art and Thought* (London: Luzac and Co., 1947), pp. 180–85, at pp. 181–2.

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