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The Revival of Natural Theology in Contemporary Cosmology

The recent use of cosmology to make theological claims is critically reviewed, with special reference to the work of Hawking, Davies, Hoyle, Polkinghorne, Houghton and Van Till. Their scientific arguments are presented and four basic approaches to the relationship of science and theology are identified. The reason for this recent revival of natural theology is analysed with its limitations and dangers.


1. Introduction

Natural theology can be broadly defined as 'the attempt to attain an understanding of God and his relationship with the Universe by means of rational reflection.' It has been suggested that in the history of religious thought it has the 'irrepressible quality of a yo-yo'. The scientific revolution of the seventeenth and eighteenth centuries gave the design argument prominence with Newton's quantitative account of celestial motions allowing the beauty and order of the heavens to be used to demonstrate God's creative power, wisdom and providence.

However, in much of the nineteenth and twentieth centuries natural theology has suffered from the philosophical and theological criticisms of Hume, Kant and Barth. More effective in popular and scientific literature in suppressing natural theology has been the impact of Darwinism in giving an alternative explanation of design. The advance of scientific knowledge has slowly squeezed out the 'God of the gaps' of much of the previous natural theology.

It is therefore surprising that it is within the scientific community itself that natural theology has been recently undergoing a revival, particularly in the advance of scientific knowledge concerned with the origin and structure of the Universe. It is generally agreed, on the basis of the redshift of galaxies, the microwave background radiation and the theoretical prediction of the observed hydrogen-to-helium ratio, that the origin of the Universe is well described by the model of the hot big bang, with the

Universe expanding from a singularity some $15.10^9$ years ago. Recently, there has been growing appreciation of the anthropic fruitfulness of the Universe, that is, the structure of the Universe seems to be sensitively tuned to the existence of life. For example, Barrow and Tipler point to the age and size of the observable Universe, nuclear energy levels in beryllium and carbon, the remarkable properties of water and the amount of oxygen in the atmosphere. All these things are essential to the existence of carbon-based life and are determined by subtle balances among the forces of nature.

This paper will assess the ways in which these scientific insights have been used in the last decade to make theological claims. We will consider the treatment of science and religion, the claims that are made and the concept of God that is obtained. As the significance of this revival of natural theology is that it has occurred amongst professional scientists we will not consider those who are primarily theologians. We will consider physicists who illustrate four basic approaches to the use of cosmology in theology. Firstly, the approach where science continues to close any gaps for God, and therefore there is no need to talk of a Creator. The second approach is that which dismisses revelation and religious experience yet still believes that science can provide a surer path to God. The third and fourth are the approaches of scientists with Christian convictions, the key difference being in their view of revelation and therefore the degree of interaction between science and theology. Finally, we will assess the value of cosmology to natural theology and the reasons for its recent revival.

2. 'No Gaps for God?'

Carl Sagan in an introduction characterizes the first 'popular' book of Stephen Hawking, Professor of Mathematics at Cambridge, as,

'a book about God ... or perhaps about the absence of God ... a universe with no edge in space, no beginning or end in time, and nothing for a Creator to do'.

For Sagan and Hawking, it is clear that God is irrelevant to any description of the Universe, modern science having closed any gaps for God. The book has achieved phenomenal sales, 600,000 books being in circulation in the USA alone by November 1988. Hawking's aim is for a complete description of the Universe by means of a single theory which not only describes how the Universe changes with time but also the initial conditions. At the heart of such a theory is a unification of general relativity and quantum mechanics, that is a quantum theory of gravity.

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2.1 Hawking and Quantum Gravity

The standard model for the big bang leaves important questions unanswered such as why was the early Universe so uniform on a large scale and so near the critical rate of expansion, that is, at the Planck time \((10^{-43}\text{s})\) the explosive force of the big bang was balanced to within 1 part in \(10^{60}\) of the gravitational force. In addition, the origin of the density fluctuations which eventually led to galaxy formation is not specified.

One possibility is that if the Universe was spatially infinite (or there were infinitely many universes), we could be living in a region that by chance was smooth and regular with the initial state chosen randomly. The anthropic principle would then 'select' the Universe we exist in. However, Hawking raises two objections. Firstly, in what sense do other universes exist if they have no observable consequences, and secondly, why are there so many other galaxies when only one would be sufficient for life to exist?

An alternative possibility, using 'inflationary' models of the early Universe, is to show that quite a number of different initial configurations would have evolved to produce a Universe like the one we observe. Such models, which postulate an early exponential expansion, naturally explain the uniformity of the Universe and the rate of expansion after the inflationary phase would automatically become very close to the critical value without assuming carefully chosen initial conditions. These models are significant as they mean that the initial state of the Universe did not have to be chosen with great care.

However, it cannot be the case that every initial configuration would have led to a Universe like the one we observe. Hawking sees these questions linked to the initial conditions of the big bang, but questions that the present theory of general relativity cannot answer. This is due to general relativity breaking down at the singularity of the big bang, as at that point there is infinite curvature and density, and as a 'classical' theory it cannot describe strong gravitational fields where the effects of quantum theory should be important.

It is here that a quantum theory of gravity becomes important. This would answer some of the above questions by a principle, a 'theory of everything', that picked out one initial state and hence one model of the Universe. Building on his work on the evaporation of primordial black holes, while acknowledging that a complete and consistent combination of quantum mechanics and gravity has not been achieved, Hawking nevertheless believes that some of its features are fairly certain. One such feature would be to use Euclidean space-time which has the result:

'It is possible for space-time to be finite in extent and yet have no singularities . . . at which the laws of science broke down and no edge of space-time at which one would have to appeal to God or some new law to set the boundary conditions of space-time'.

7 Ibid. p. 135–136.
The key idea here is that the Universe is described as a 4D version of a sphere, with the fourth dimension being time.

This 'no boundary' condition may also explain various aspects of the Universe. Firstly, the beginning of time would be a regular, smooth point of space-time and the Universe begins its expansion in a smooth and ordered state thus explaining the large scale uniformity. Secondly, the Universe began with the minimum possible non-uniformity allowed by the uncertainty principle. Inflation would amplify these non-uniformities leading to structures such as galaxies.

Hawking examines the possibilities of string theories uniting gravity and quantum mechanics into a complete unified theory. These theories still have severe problems but he has the faith to think that a complete unified theory is possible within this generation.

Before turning to the theological implications of this, it needs to be stressed that Hawking's views on quantum gravity are speculative, that is, they are not widely accepted and at present it is not clear whether some things will work, even to the extent of whether quantum theory can be legitimately applied to the whole Universe. Barrow\(^8\) discusses the question of singularities at some length and concludes that until we better understand the nature of time we will not know whether the no boundary ideas are correct. Gingerich\(^9\) and Tipler\(^10\) go even further, criticizing Hawking's 'sleight of hand', noting that the no boundary condition simply replaces the classical singularity by a quantum singularity. That is, the four dimensional sphere of zero radius forms a boundary condition to Hawking's universe. Thus the no boundary condition is not fully implemented. Furthermore, we may add that it is not clear that the no boundary condition with inflation will solve the galaxy formation problem and there is the more fundamental problem, which Hawking admits, that such a model may be too mathematically complicated for exact predictions to be calculated.

2.2 Theological Implications

Hawking's theological motivation seems to be a reaction to an audience with the Pope during the 1981 Vatican conference on cosmology:

'He told us that ... we should not inquire into the big bang itself because that was the moment of Creation and therefore the work of God'.\(^11\)

It is clear that Hawking profoundly disagrees with this 'God of gaps' attitude, even to the extent of possibly seeing himself as a latter day Galileo. It should be noted that Tipler\(^12\) has pointed out that the published version of the Pope's address on that occasion is quite different to that which

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Hawking reports, and did not presume to set limits to scientific inquiry about the initial singularity, but argued that metaphysics was needed to answer the question of why the Universe exists at all.

Nevertheless, Hawking believes his ‘theory of everything’ has profound theological implications. If the no boundary proposal is correct, God had no freedom at all to choose initial conditions and:

‘The Universe would have neither beginning nor end: it would simply be. What place, then, for a Creator?’\(^{13}\)

Hawking’s view seems to be deistic, neglecting the view of God as sustainer:

‘Most people believe that God allows the universe to evolve according to a set of laws and does not intervene in the universe to break up these laws . . . but it would still be up to God to wind up the clockwork and choose how to start it off. So long as the universe had a beginning, we could suppose it had a Creator’.\(^ {14}\)

Through a unified theory which specifies the initial conditions such a deistic Creator becomes irrelevant.

A similar view was presented by physical chemist P. W. Atkins who argued that the Universe arose from a fluctuation ‘by chance’ and therefore there is nothing for an ‘infinitely lazy creator’ to do.\(^ {15}\) Stenger has also recently argued that as the ‘design’ of order has come about entirely by chance there is no need for a designer.\(^ {16}\)

What can be said of such claims? In the first place, such a ‘theory of everything’, even if free from scientific difficulties, still leaves questions unanswered. Polkinghorne rightly points out that Hawking has still to ‘smuggle in’ the requirement that the Universe must have gravity and quantum behaviour. In addition, Barrow argues that the structure of the Universe is not determined or ‘understood’ when we know all the laws of nature. There are boundary conditions and spontaneous symmetry breakings which determined the values of particular observed quantities and there are anthropic selection effects. These features:

‘are perfectly consistent with the laws of physics but not uniquely derivable from them even when initial conditions and evolutionary laws are precisely known. A knowledge of a ‘Theory of Everything’ would shed no more light upon them than knowledge of Newtonian gravity sheds upon the direction of the rotation of the Earth on its axis or the number of planets in the solar system’.\(^ {17}\)

To be fair to Hawking it does seem that he recognizes these points acknowledging the question of why should there be a Universe for the

\(^{13}\) Hawking, op. cit., (6), p. 141.

\(^{14}\) Hawking, op. cit., (6), p. 140–141.


model to describe? Whether the unified theory is so compelling that it brings about its own existence or whether it does need a Creator, Hawking seems to be a little inconsistent in eventually issuing a plea for metaphysics.

Secondly, both Hawking and Atkins take as an assumption without justification that:

'we are rational beings who are free to observe the Universe as we want and to draw logical deductions from what we see'.

However, this is surely an aspect of the Universe which needs explanation. Indeed, this question for other writers, such as Polkinghorne, is basic to natural theology.

Thirdly, the identification of God as exclusively deistic Creator makes God vulnerable to being pushed out of ‘the gaps’. No consideration is given to revelation or religious experience which may point to God as sustainer and law-giver of the Universe.

Finally, this is a popular ‘conflict’ approach to the relationship between scientific and theological description, that is both descriptions say the same kind of things about the same thing. It means that the existence of a scientific description of an event invalidates its consideration as God’s creative activity. There is no concept of complementarity of scientific and religious descriptions which would allow a totally naturalistic account of creation but not see this as ruling out a providential account. Such an approach will be reviewed in Section 5.

By taking this deistic view, ‘natural theology’ becomes limited to the initial conditions of the Universe and of course is very negative. With such a deistic view even if the question ‘why should there be a Universe’ needs a Creator, Hawking inevitably raises the question of who created God?

3. ‘A Surer Path to God?’

It has been suggested that the explosion of natural theology in the eighteenth century had its basis in a decisive shift in the balance of importance accorded to revelation and reason with a swing towards the latter. In recent years, both Paul Davies, Professor of Theoretical Physics at Newcastle, and Sir Fred Hoyle would follow such a swing. Neither have any time for traditional Christian theism and would claim:

‘It may seem bizarre, but in my opinion science offers a surer path to God than religion . . . science has actually advanced to the point where what were formerly religious questions can be seriously tackled’.

Davies' aim is to apply modern physics to these 'questions of existence' such as how did the Universe arise, while Hoyle's primary purpose is to show that orthodox terrestrial biology is mistaken in assuming that it has not been 'spurred on through evolution by a force outside the Earth itself'. The fascinating thing is that with different purposes and quite different views of cosmology they end up with very similar theological conclusions.

3.1 The Contrasting Cosmologies of Davies and Hoyle

Davies' foundation is the standard model of the big bang. Within this, the question arises of whether the circumstance of the Universe can be explained, that is its complexity and order? Similar to Hawking, Davies rejects any coupling of the weak anthropic principle with some theory of many universes and sees that inflationary models of the early Universe mean that the Universe need not have been created in a special ordered state. It is only if these models fail and the anthropic argument is rejected that the circumstance of the Universe might be advanced as evidence for a cosmic designer. However, for Davies this is only negative evidence and he expects that current physical theories will give an adequate explanation of these features.

In the light of this statement, it seems remarkable that in discussing the fundamental constants in the laws of nature he claims:

'the seemingly miraculous concurrence of numerical values that nature has assigned to her fundamental constants must remain the most compelling evidence for an element of cosmic design'.

Hoyle who takes on both orthodox biology and cosmology in his own characteristic way argues that life on earth is of cosmic origin. Particular life forms into which the basic cosmic components, genes, are assembled are decided by the specific environment of the Earth. He then turns to the 'sickly pall' which hangs over big bang theory as he claims it does not explain the clustering of galaxies. Instead he advocates a steady state Universe with 'little bangs' and no explicit beginning while the microwave background radiation is starlight scattered by micro-organisms in space. All of these claims are of course hotly disputed by the majority of the scientific community.

Nevertheless, all of this leads both Davies and Hoyle to 'religious connotations'. Both consider the future of human technology, artificial intelligence and its possible degree of control over the natural world. Davies suggests that there is no conflict between a Universe evolving according to the laws of physics but nevertheless subject to intelligent control. It is from this basis that he suggests a 'natural God' who operates within the laws of nature, directing and controlling the evolution of the cosmos. A possible 'theory of everything' would mean that perhaps the

laws of the Universe will emerge to be the only logically possible physical principle. This makes the idea of a creator God redundant but does not rule out a 'natural God'.

With a similar model of human manipulation Hoyle arrives at a similar 'intermediate' intelligence responsible for the anthropic balances necessary for carbon based life, but also 'a very large scale' intelligence acting from the future providing information necessary for the development of life and drawing the Universe towards its eventual fulfilment.

This consideration of the future of human manipulation of the Universe has also been used by Barrow and Tipler in proposing their own Final Anthropic Principle:

'Intelligent information-processing must come into existence in the Universe, and once it comes into existence, it will never die out'.

Human culture, possibly maintained by other hardware than human bodies will eventually engulf the entire cosmos. At this 'omega-point', life,

'will have stored an infinite amount of information, including all bits of knowledge which it is logically possible to know. And this is the end'.

In fact Tipler is prepared to identify this omega point with 'God', the ascent of life to this omega point meaning that humanity will eventually live in the 'mind of God'.

3.2 Theological issues
What then are the theological presuppositions and conclusions of Davies and Hoyle? Hoyle has always been quite clear about his negative views on Christianity although he does recognize some sort of religious impulse, a feeling of being derived from 'something out there'.

For Davies the progress of science is seen as the major reason for making the biblical perspective of the world largely irrelevant. Religion is founded on 'received wisdom and dogma' which 'purports to represent immutable truth', in contrast to science which is founded on observation and experiment. He explicitly states that he makes no attempt to discuss religious experience or morality. This unwillingness to take account of religious experience, as Polkinghorne has stressed, is one of the reasons why Davies develops a God who is not transcendentally other but more of a 'demiurge'.

Much the same can be said of Davies' treatment of revelation.

26 Tipler, P. J. 'The Omega Point as Eschaton: Answer to Pannenberg's Questions for Scientists', (1988), Preprint.
28 Davies, op. cit. (20), p. 6.
29 Davies, op. cit. (20), p. 220.
revelation in the Bible is rarely considered and 'revelation' is seen simply as truth directly communicable to the believer. The biblical version of creation is stated to be vague and the fact that no detailed analysis is given illustrates the view that the Bible has little relevance to the discussion.

In the area of natural theology Davies dismisses the cosmological argument with the problems of 'what caused God', the concepts of cause and effect being firmly embedded in the notion of time and the possibility of quantum cosmology. He does not advocate the design argument in connection with the circumstance of order and complexity in the Universe, believing that current physical theories will provide a satisfactory explanation of these features. However, he does not seem able to follow this philosophy through concerning laws, that is the fine-tuning of the fundamental constants, which he believes to have been carefully 'thought out'. In his most recent book, he argues that belief in a designer is not unreasonable, but in a recent article stresses that it is 'subjective'.

'for it is hard to see how science can ever answer this ultimate question'.

It is interesting to contrast this latter statement with Davies' earlier confidence in a surer path to God!

Why are Davies and Hoyle led to make such theological statements? Polkinghorne has suggested that it is in response to a basic need to feel that there is purpose at work and hope in the world. This is surely correct, but another important factor is a response to a sense of 'awe' at the Universe. Davies constantly speaks of a 'reverence' when approaching the Universe, with the inspiration, delight and wonder of science. As will become clear this sense of awe is an important factor in much of the motivation for natural theology and is shared by many scientists who have no 'religious' convictions.

It is in this context, then, that they develop the idea of an intelligence firmly within the Universe and subservient to it. The development of mankind's future control over the Universe becomes a model for a controlling intelligence within the laws of physics. For Davies this natural god or demiurge,

'would not be omnipotent for he could not act outside the laws of nature. He would be creator of everything we see, having made matter from pre-existing energy, organized it appropriately ... but he would not be capable of creation out of nothing'.

This 'supermind' working to achieve specific purpose seems at times to be totally identified with the Universe, while at other times Davies is more reminiscent of Oriental mysticism:

‘the Universe is a mind: a self observing as well as self organizing system . . . God . . . is the unifying consciousness of all things’.\textsuperscript{34}

Such a god cannot prevent the death of the Universe, whether it be by big crunch or heat death and only a cyclic or steady state Universe would allow this natural god to be both infinite and eternal.

Therefore, the use of the design argument and the model of future human advance has led to a god who is not transcendent but contained by the Universe and its laws. Neglecting revelation and religious experience it is not surprising that Davies and Hoyle illustrate the criticism of Hume and Kant that the design argument does not lead to an infinite creator but at most to a cosmic architect using existing material. Martin\textsuperscript{35} has pointed to a similar conclusion in the thought of Professor B. Josephson, the Cambridge solid state physicist. Josephson sees God in the chaotic quantum fluctuations which quantum field theory would claim to exist even in a perfect vacuum. But for Josephson, as for Davies and Hoyle, God resides within the Universe. In such an approach the distinction between God and nature becomes terribly blurred, and is reminiscent of the impersonal pantheism of Spinoza.

The ‘surer path to God’ has led to a god remade to harmonize with the prevailing scientific ethos. Hanbury Brown, the Australian astronomer, has recently stated that this is what needs to be done to religion. The idea of God as person is dismissed as belonging ‘to an earlier simpler stage in the history of thought’.\textsuperscript{36} Davies suggests that his god ‘might well be enough to satisfy most believers’,\textsuperscript{37} but it is clear that this is not the same God as the God of Abraham, Isaac and Jacob.

4. ‘Fruitful Interaction?’

The revival of interest in natural theology can also be seen amongst scientists who stand directly within the Christian tradition and see the discoveries of modern cosmology to be of the utmost importance for their view not only of creation but also of Creator. One such writer is J. C. Polkinghorne, former Cambridge Professor of Mathematical Physics, who in a recent series of books\textsuperscript{38,39,40,41} has argued,

‘science and theology seem . . . to have in common that they are both

\textsuperscript{34} Davies, op. cit. (20), p. 213.
\textsuperscript{37} Davies, op. cit. (20), p. 211.
exploring aspects of reality. They are capable of mutual interaction which, though at times puzzling, can also be fruitful.\footnote{Polkinghorne, op. cit., (39), p. xi.}

One of the forms of this interaction is a revised natural theology. Sharing such an approach are D. J. Bartholomew, Professor of Statistical and Mathematical Science at LSE\footnote{Bartholomew, God of Chance, London, SCM, (1984).} and the former biologist A. R. Peacocke.\footnote{See e.g. Peacocke, A. R. Creation and the World of Science, Oxford, OUP, (1979).}

\subsection{Revised Natural Theology}

Polkinghorne sees the intellectual quest of the new revised natural theology as part of the Thomist tradition of the search for a unified understanding. However, accepting the criticisms of Hume, Kant and Darwin means that any logically coercive claims of `proofs' are demolished. Nevertheless, those arguments raise issues which have value as sources of possible insight into the way the world is. A realization of this leads to a natural theology which is `insightful' rather than demonstrative.

Therefore, the insight of the classical cosmological argument is that of the intelligibility of the Universe. It is a striking and non-trivial fact that the pattern of mathematics is realized in the physical structure of the world and that our minds are able to solve problems that the physical world presents. For this assumption of intelligibility used by science, Polkinghorne sees the most reasonable explanation as the existence of a Creator who is the common ground of the rationality of our minds and the Universe.

The insight of design is that of anthropic fruitfulness of the Universe represented by the recognition of the potentiality inherent in the structure of the world and its tightly knit character, illustrated by the anthropic balances of the big bang. Inflationary models may be correct in explaining some of these balances but Polkinghorne argues that these models are only themselves possible because of the nature of fundamental laws. He rightly sees theories of many universes as metaphysical speculation whereas an explanation of more economy and elegance would be that the world is created by a Creator who wills it to have anthropic fruitfulness. The potentiality inherent in the structure of the world is represented by the interplay of chance and necessity which characterizes the evolution of the Universe.

Thus, the revised natural theology points to the scientific `given' of law and circumstance rather than to particular occurrences and consequently is not a return to God of the gaps. Polkinghorne sees problems with alternative insights, such as a theory of everything (see Section 2), but even if these problems were solved, this would reduce the anthropic fruitfulness insight to the intelligibility insight. This latter insight Polkinghorne sees as the one with the highest prospect of endurance although he also believes that there will remain a degree of balance necessary for life and irreduci-
bility given in scientific terms. The primary value of this natural theology is that it is a response to the world that science discloses. However, he does see that it has its limits, bringing us only to a 'Cosmic Architect or Great Mathematician' rather than to a full knowledge of the God of Christian theism.

Polkinghorne seems to lay a stronger emphasis on natural theology than Peacocks who is rather more reserved:

'Ve cannot expect today to develop a natural theology whereby we can hope to read off as it were the nature and attributes of the deity... from the world of nature. Nevertheless our understanding of God's relation to the world, the doctrine of creation, cannot remain unaffected by our new found knowledge'.

Bartholomew is even more reserved, warning against a 'significance test for theism' and in a recent article is dismissive of anthropic fruitfulness. This is perhaps due to their scientific backgrounds. One might expect someone working in Darwinian evolution and someone in statistics to be more reserved than those who have encountered the insights of fundamental physics.

What is the theological base of this revised natural theology? Firstly, Polkinghorne is convinced that if God is Creator the world is not neutral but must have marks of his character, however veiled. Following on from this, secondly, natural theology is based on the fruitful interaction of science and theology, that is both are needed for the deepest possible understanding.

This view of science and theology is based on a critical realist view of the nature of science, that is, the achievement of science is a 'tightening grasp of actual reality'. In a similar way, theology is seen as a response to the way things are, conjoining logical analysis with intuitive acts of judgement. For Polkinghorne, tradition provides the corrective to acts of personal judgement and scripture can be used as data for critical assessment. However, it does seem that at times both tradition and scripture fall into the same category of religious experience. For example, scripture is,

'the historic record of experiences of particular illumination rather than a guaranteed packet of timeless propositions'.

This is a significant difference to the approach that we shall describe in Section 5. Polkinghorne sees religious experience to be of prime importance. He defends,

'widespread claims to the experience of a religious dimension to reality; of encounter with numinous presence of an Other; the recognition of

45 Ibid., p. 46.
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unity with reality transcending oneself; the perception of a purpose at work in the world . . .; the acknowledgement of an ultimate significance to be found in the way the world is'.

This is an important passage. The transcendence and immanence of God come through experience. There is also an experiential basis to natural theology. Elsewhere he writes of 'our intuitive feeling' that the anthropic balance of the world is significant. Like others he speaks of a sense of awe at the Universe, being 'excited' and 'deeply moved' at the fruitfulness inherent in the laws of atomic physics. This sense of awe fits easily with religious experience in speaking of a transcendent reality.

In view of this, it may seem that Polkinghorne has little concept of objective revelation. This is probably the case concerning scripture but must not be pressed too far. He frequently refers to a 'Christian understanding' or the 'classical doctrine of creation' to undergird theological statements. Barclay characterizes him as an orthodox Christian influenced by existentialist theology. He certainly rejects Barth believing that there are other forms of insight outside scripture. It is openness to these insights which makes natural theology possible and leads to theological consequences.

4.2 The God of Revised Natural Theology

The concept of fruitful interaction means that changes in scientific understanding must modify the tone of theological discourse. The insights of natural theology into the way the world is must reflect the characteristics of creation and Creator.

Therefore, for both Polkinghorne and Bartholomew the consequent vulnerability of the Universe characterized by the interplay of chance and necessity is more consistent with, 'the divine Juggler rather than the divine Structural Engineer'. A world of being and becoming finds resonance with a God of faithfulness and love, and a God who has both eternal and temporal aspects. The freedom given to the Universe in such a picture means a kenosis of God in power and knowledge. Thus, as a result of one of the insights of natural theology, a God of determinism is replaced by a view of God much more 'in process', although stress on the reliability of physical law stops Polkinghorne going to the extreme of process theology.

For Polkinghorne, a free process defence to the problem of evil follows from this freedom in the Universe. However, when it comes to the future, the futility predicted by cosmology must give way to the hope that the

49 Polkinghorne, op. cit. (39), p. 29.
50 Polkinghorne, op. cit. (40), p. 29.
52 Polkinghorne, op. cit. (40), p. 67.
ultimate fulfilment of the Creator's eternal purpose will take place beyond this world.

This raises the question of how far can the insights of natural theology go in reformulating Christian doctrine? Polkinghorne, and to a lesser extent Bartholomew, are limited by the emphasis they lay upon the insights of scripture and tradition. Peacocke possibly goes the furthest in arguing for an evolutionary or emergent Christology. In fact, Peacocke's suggestion that chance is God's way of realizing implicit potential has been criticized of coming close to deism.\textsuperscript{54} However as Poole\textsuperscript{55} has rightly pointed out, this criticism seems to be unjustified in view of Peacocke's emphasis on the immanence of God in his creation.

Therefore, from religious experience, scripture, and tradition in addition to a revised natural theology, God is seen as sustainer of his creation, his transcendence a reflection of the lawful intelligibility of the world. A God of the gaps is ruled out but the insights of natural theology enforce a view of God which sees him giving the Universe both freedom and reliability and in so doing limiting himself.

5. 'Double Consistency?'

In many ways the approach to be described in this section would agree with Hawking and advocate a scientific explanation of the origin of the Universe without the hypothesis of a God of the gaps. However, such an approach would say that such an explanation is not complete in itself. It derives from Donald MacKay's emphasis on 'complementarity', that is, that scientific and biblical statements can be different, but both true because they represent different but complementary aspects of one larger reality.\textsuperscript{56}

It has been pursued recently by conservative evangelicals including Hummel,\textsuperscript{57} Gingerich,\textsuperscript{58} Houghton\textsuperscript{59} and Van Till.\textsuperscript{60} Houghton, who is Director General of the Meteorological Office, sums up the approach as:

'looking for a double consistency. Events can and should be looked at as thoroughly as possible from the scientific standpoint. But they should also be viewed from the perspective of faith'.\textsuperscript{61}

Houghton is writing an apologetic/evangelistic book while Van Till, who

\textsuperscript{54} See e.g. Patlin, D. A. Epworth Review, (1982), 9, 72–86.
\textsuperscript{56} For a recent compilation see Mackay, D. M. The Open Mind, Leicester, IVP, (1986).
\textsuperscript{61} Houghton, op. cit., (39), p. 115.
is Professor of Astronomy at Calvin College, seems to be writing much more for Christians in the USA against the background of the creationism debate. It is important to be aware of these different aims because on the surface these books appear very different, and yet they share similar understandings concerning the relationship between cosmology and theology.

5.1 The Biblical View
Van Till devotes almost a third of his book to a discussion of the nature and interpretation of the Bible. He affirms its status as the ‘Word of God’ rather than just a collection of religious experience while acknowledging the different forms of human language and literature. Interpretation is therefore to distinguish between ‘vehicle’ and content, that is the ‘trustworthy teachings of God’. In such a distinction, he argues that the Bible tells us that the Universe is neither self-generating or self-sustaining but has the status of Creation and the character of God’s creative activity is as originator, sustainer, governor and provider of that Creation. Due to the time and the manner in which the Bible was written, divine action is in figurative, anthropomorphic and poetic terms unsuitable as a scientific description. Specifically, Genesis 1 is seen as a ‘poetic or liturgical story of origins’.62 The basis of all this for Van Till is the authority of the Bible, confirmed by the testimony of the Holy Spirit, in giving us revelation that God is the Creator of the entire Universe.

Houghton gives a much smaller consideration to biblical revelation but argues that we only really discover God if God chooses to communicate with us concerning his grace, love, transcendence and immanence.

Therefore, the revelation of God given in the Bible establishes him as Creator and the status of creation, but to obtain specific details of cosmic history one must turn to an observational study of creation itself.

5.2 The Scientific View
Both Houghton and Van Till give the standard evidence for the big bang. Houghton goes on to discuss anthropic balances but briefly outlines the possibility that these features may be explained by scientific theory. He also feels, with Hawking, that it is likely that a scientific description of the initial singularity may eventually be provided. In fact, Houghton does not find it surprising that the Universe appears to be complete and self contained as the greatest possible designer would design a Universe reliable, precise, without the need for continual adjustment and with a high degree of ‘fault tolerance’.63 He criticizes reductionism and advocates hierarchies of description. Thus, a scientific description of chance, for example, is not an explanation:

"Because scientific descriptions of some event may involve chance and"

62 Van Till, op. cit., (60), p. 11.
63 Houghton himself has been involved in remote sensing and spacecraft design!
probability it does not follow that a theological description of the same event in terms of God’s activity need also involve chance. 64

Van Till is even more explicit concerning the limits of natural science. It deals only with ‘internal affairs’ which means that it cannot answer questions concerning the cause of existence of the cosmos, value or purpose:

‘because that might involve the action of non-material entities or beings which by their very nature are beyond the reach of scientific investigation’. 65

Science is thus bound by the ‘real world’ and excludes from its consideration the very dimension that the Bible emphasizes, that is the relation between Creation and Creator.

5.3 The Degree of Interaction of the Two Views

Van Till categorizes questions concerning the Universe into ‘internal affairs’ and ‘external relationships’, the latter being ultimately the domain of scriptural authority. Each of these domains is different but not contradictory and suggests the term of ‘categorical complementarity’. The result is that neither the scriptural or the scientific view of the cosmos is complete in itself. In such an approach, God is of course transcendent and immanent, but the cosmology has little effect on the view of God. Therefore, it is not surprising that natural theology is almost ruled out. In a book of almost 300 pages Van Till only mentions it once, 66 does not elaborate on it and it is unclear whether it has any theological significance.

Houghton sees more interaction of the two views. In addition to advocating double consistency, he echoes Bacon’s two books as guides to faith. Consequently from the book of nature, ‘we learn of God’s greatness, grandeur and consistency’, 67 although without the book of God’s Word, God in his works is ‘elusive’. This opens the way to some natural theology:

‘the fact that we understand some of the mechanisms of the working of the Universe does not... preclude the existence of a designer... Many scientists, including myself, feel that even though no logical argument can be provided leading from the Universe to a designer, the evidence tends strongly to demand the existence of an intelligent being behind it all’. 68

Once again, it seems that this ‘feeling’ that there must be a designer is closely allied to his awe at the Universe. He sees ‘awe, wonder and mystery’ as strong components of the scientific enterprise and the important idea of transcendence, that is, science deals with something that is given.

Natural Theology and Cosmology

We might suggest that Van Till verges on 'compartamentalization' rather than 'complementarity' with science having little interaction with theology. Houghton, although sharing the same basic convictions about scripture allows some interaction thus opening the way for natural theology. He comes close to the position of Polkinghorne, but his emphasis upon scripture does not allow him to go as far in terms of theological consequences. In fact, in a recent paper on chaos, Houghton does not admit that recent findings have any theological implications whereas for Polkinghorne they are an important part of seeing the world and God in terms of being and becoming.

6. Conclusions

William Paley once stated that astronomy is 'not the best medium through which to prove the agency of an intelligent Creator'. This paper has reviewed four recent approaches to the relationship between cosmology and theology and in particular to natural theology. As a result, Paley seems to be right in asserting that one cannot prove the Creator, although this is due to the fact that the classic arguments are not logically coercive rather than to the nature of cosmology. However, Paley seems to be wrong to insist that no knowledge at all, can be gained from cosmology. I would like to suggest that a revised natural theology is valuable as long as its limitations and dangers are clearly noted.

6.1 The Value of Natural Theology

It is interesting to ask why this 'phenomenon' of revival of interest in natural theology has occurred in recent years. The flowering of natural theology in the past has been ascribed to the influence of Greek philosophy, decreasing emphasis upon the Bible or its social function in maintaining the status quo. No doubt the factors leading to the recent revival are complex, but one of the main factors is surely that it is a response to the recent discoveries of fundamental science concerning the way the world is. The fact that someone like Davies, who is clearly not sympathetic to traditional religion, recognizes that these questions need to be addressed is important. If it were only Christians propounding the new natural theology then one might explain it simply as a reaction to the recent undervaluing of natural theology. However, the insights of intelligibility and anthropic fruitfulness have thrown up questions which science itself is unable to answer. Attempts to answer these questions in terms of 'theories of everything' or anthropic principles, even if able to give an account of initial conditions of the Universe, do not remove the metaphysical questions. Barrow, in concluding his recent book on the nature of the Universe, recognizes that science itself may not be able to answer all of the questions:

‘then any boundary between fundamental science and metaphysical theology will become increasingly difficult to draw. Sight must give way to faith’.70

In the revival of natural theology in cosmology, not only have we observed the convergence of fundamental science and metaphysics, it has also been striking that common to all approaches is a sense of awe at the Universe that science discloses and often a subjective ‘feeling’ that there must be more to the Universe than meets the eye. This has a long history in scientific thought. It may be argued that modern society has lost some of its sense of awe, but the vastness, beauty and simplicity of the Universe seems still to invoke a response. This should not be ignored by scientists and Christian apologists.

Therefore, Polkinghornes is correct in stating that the value of natural theology is that it is ‘a rational response to the strange and beautiful world that science discloses’.71 In this way it does express the fruitful interaction of science and theology. The idea of complementarity is extremely helpful in avoiding the ‘conflict’ model used by Hawking, allowing the scientist to look for double consistency, in terms of a possible ‘theory of everything’ and a providential account. While this avoids the problem of God of the gaps, if pressed too far it can cause problems. For example, Van Till strays towards compartmentalization leaving little room for discussion with someone like Atkins who rejects the religious discourse level by faith.

It is surely more satisfactory to accept complementarity, but acknowledge that in integrating these different insights into the nature of reality, there are points of interaction such as natural theology. This position is consistent with the wisdom literature and other parts of the Bible which encourage Christian thinkers to seek evidence of God in the Universe as well as in the Scriptures (e.g. Ps. 19:1; Acts 14:7, 17:22–31; Rom. 1:18ff.). If God is Creator, then one would expect that theological and scientific descriptions of creation would interact. In fact such an interaction is witnessed by the strong claim that the Christian doctrine of creation was indispensable for the birth and development of the natural sciences.72 Such interaction and the possibility of some natural theology can be of apologetic importance providing a point of contact between such people as Davies and Houghton. It is interesting to note that even a stronger stress on biblical revelation than Polkinghornes is prepared to admit does not rule out this mutual interaction. For example, Packer acknowledges:

‘the facts of nature yield positive help in many ways for interpreting Scripture statements correctly, and the discipline of wrestling with the

70 Barrow, op. cit., (8), p. 373.
problem of relating the two sets of facts, natural and biblical, leads to a greatly enriched understanding of both.\textsuperscript{73}

However, does such a revised natural theology avoid earlier criticisms? Firstly, natural theology has been criticized on the basis of circularity. For example it can be argued that theistic deductions from Newtonian science were only possible because the science itself was based on a strong theistic creed. As Polkinghorne's theological base for natural theology is the claim that because God is creator the Universe is not a neutral theatre, then his natural theology does have an element of circularity about it. However, by limiting natural theology to insights rather than demonstrative proofs, the logical problems of earlier natural theology are avoided and the task becomes one of showing that a theistic account of the Universe is coherent. In fact all metaphysical schemes are in some sense circular. It is interesting that a number of such schemes can be built from the scientific view of the world, for example, Monod\textsuperscript{74} and Polkinghorne coming to very different conclusions from the phenomenon of chance and necessity. The strength of the theistic account is that it claims to integrate not only the scientific phenomenon but also religious experience and historical revelation.

Secondly, natural theology has been criticized on the basis of particularity, that is only highlighting some things in nature and ignoring waste, pain and lack of purpose. In modern cosmology, this criticism can be put as highlighting intelligibility and anthropic fruitfulness while ignoring the ultimate fate of the Universe or even extra-terrestrial intelligence. Whether the Universe ends in big crunch or more likely in view of recent observations in heat death, its fate is one of futility. It is possibly in response to this lack of hope that Tipler in particular develops the Final Anthropic Principle and gazes forward to the Omega point. Those who stress biblical revelation can point to the ultimate fulfilment of God's purposes beyond this world, but those who do not have this stress need to take this aspect of futility seriously in natural theology. Eschatology is an essential part of any doctrine of creation. The same might be said of the possibility of extra-terrestrial intelligence. Davies emphasizes its importance:

'th Shattering completely the traditional perspective of God's special relationship with man'.\textsuperscript{75}

However, Jaki\textsuperscript{76} responds that it is only the theist who can look forward with confidence to such an encounter, trusting that both sides will have a common Creator and a sense of brotherhood!

In view of these criticisms, what are the limitations and dangers of this revival of interest in natural theology?

\textsuperscript{75} Davies, op. cit., (20), p. 71
6.2 The Limitations of Natural Theology

The first limitation is to note with Polkinghorne that at best this new natural theology will only lead to a Great Architect rather than the Christian God. This limitation is illustrated clearly by Davies, who neglects revelation and religious experience and ends up with a ‘demiurge’, whose nature and action are left without explanation and is hardly a God worth commitment.

Secondly, it needs to be stressed that natural theology depends on human initiative and insight which in itself is severely limited. Although the revival of interest in natural theology is a widespread phenomenon it is not universal and many scientists ignore or avoid theological questions. Amongst those who propound the new natural theology there is little or no consideration of sin, that is that human insight and reason are corrupt. Simply to accept that there are insights in nature does not mean that Barth can totally be ignored. Human sin must surely be considered as a limitation to natural theology.

The third limitation is that scientific insights can soon be out of date. For example, Hawking’s theological inferences depend on quantum cosmology which is in itself at an early stage of development and models can change very quickly. Therefore, theologians need to be cautious as a natural theology built only on anthropic fruitfulness runs the risk that a future theory of everything may destroy it.

6.3 The Dangers in Natural Theology

Alongside these limitations, this study has also illustrated four dangers inherent in natural theology. Firstly, there is the danger of anthropocentricity. Davies and Hoyle take human advance as a model for their own ‘supreme intelligence’. The danger is that ‘God’ becomes made in the image of man. Secondly, Davies and Hoyle also illustrate the danger of pantheism. The distinction between nature and divinity is carelessly blurred and Davies’ ‘natural God’ could equally be ‘Nature’. The difference between this and the Christian doctrine of creation was emphasized by C. S. Lewis:

‘To say that God created nature, while it brings God and nature into relation also separates them. What makes and what is made must be two, not one. Thus the doctrine of Creation in one sense empties nature of divinity. How very hard this was to do and still more, keep on doing, we do not now easily recognise’.77

Thirdly, Hawking in particular illustrates the danger of deism, which accompanied the growth of natural theology particularly in the seventeenth century. This remains a danger for those who do not stress God as sustainer of the Universe. Finally, the danger of a God of the gaps is never too far away from natural theology. Davies comes close to this, when unable to find any adequate explanation at present for the fine-tuning of the funda-

mental constants, seems to suggest that they are evidence for the work of a designer. It is this concept, that God copes with the left over that present physical law cannot explain, which both Hawking and Houghton react to with different consequences.

6.4 Natural Theology and Revealed Theology

How then can a revised natural theology be applied in cosmology with a consideration of its limitations and an avoidance of its dangers? The answer is surely that natural theology is brought within the embrace of revealed theology. It is primarily because Davies neglects experience and revelation that he strays into pantheism and is severely limited in his knowledge of God. Within the context of revealed theology one is able to hold together immanence and transcendence, human fallibility and human responsiveness, the insights of creation which point to a Creator and those insights which do not. Revealed theology can go some way to answering the questions raised by natural theology. It is significant that the contexts of those biblical passages which seem to encourage natural theology stress that this general knowledge of God needs correcting and expanding by special revelation. Torrance is therefore correct to state that:

‘Natural theology in itself alone is incomplete . . . for it makes use of concepts and theorems which lack meaning and cogency in themselves but which may become meaningful and cogent when they are sublimated and interpreted from the level of divine revelation’.78

For that reason, in the different approaches we have reviewed, the best seems to be a combination of Polkinghorne and Houghton. That is, complementarity with fruitful interaction, the insights of nature and the insights of God's Word in order for a complete picture to be gained. In this approach natural theology has a basis in cosmology.

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