Science, Theology, and Ethics

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Chapter 1

Theology and Science: Where Are We?

Is the war being fought between evolution and creationism characteristic of the larger relationship between science and theology? Is warfare the best extended metaphor for understanding how scientific knowledge and Christian faith get along? The battle metaphor goes back to the late nineteenth century, most probably to the influence of the notorious book by A.D. White, *A History of the Warfare of Science with Theology*.[1] However, we will ask here: does the image of a declared state of war accurately describe the current interaction between theological thinking and natural science? No, not completely.

We could say that a revolution is underway, but this revolution is turning us toward greater peace, not toward new battles. It is a revolution that adds complexity and nuance so that it is no longer accurate to see science and theology merely as pitched enemies. The revolution is being led by an unpredicted and astounding intellectual trend, namely, the relocation of the God question within the orbit of scientific discussion about the natural world. The raising of theological questions within the scientific camp does not fit neatly into the warfare model.

The warfare model is not the only one. Some of us work with a model of separation. We assume that science and religion are separate, unable to conflict because they are soverign in different spheres. They allegedly speak different languages. So, we erect a high wall of separation between church and laboratory. Yet now, as the peaceful revolution is beginning to take hold, this separation is increasingly recognized as most unfortunate. It is unfortunate because we all are aware that there is but one reality. Sooner or later we will become dissatisfied with consigning our differences to separate ghettos of knowledge.

The pre-revolutionary separatists and the revolutionary scientists represent only part of the picture. There is another group of quiet revolutionaries who since the 1960s have been looking for parallels, points of contact, consonance, crossovers and conflations. Their emerging new discipline, as yet without a name, is studying developments in natural science – especially physics and the life sciences – and is engaging in serious reflection on various loci of Christian doctrine. Scientists and theologians are engaged in a common search for shared understanding. The search is not merely for a shared discipline. They are not looking merely for rapprochement between separate fields of inquiry. Rather, scientists and theologians are aiming for increased knowledge, for an actual advance in the human understanding of reality. Until a name comes along, we will refer to this new enterprise as *Theology and Natural Science*.

In this chapter, I will briefly outline eight different ways in which science and theology are currently thought to be related.[2] I will note that the dominant

view in academic circles – the truce by separation view – is what I label the 'two-language theory', but I will go on to point out that the advancing frontier is taking us in the direction of hypothetical consonance. Then, I will turn to the central methodological issue, namely, the classic concern for the relation between faith and reason. I will conclude with my own observations regarding the merits of hypothetical consonance and the value of making a theological interpretation of nature so that we can see the natural cosmos as divine creation.

Who are the key partners in this emerging conversation between natural science and Christian theology? Rather than sharply contrasting what we can know by faith and what we can know by reason, Nancey Murphy and Wentzel van Huyssteen, along with others, are maximizing the overlap. Those looking for consonance in cosmology, evolutionary theory, genetics and other such subject areas include frontier thinkers such as Ian Barbour, Willem Drees, Philip Hefner, Wolfhart Pannenberg, Arthur Peacocke, John Polkinghorne, Robert John Russell and Thomas Torrance. In Australia, we must note that Paul Davies, Mark Worthing and Denis Edwards are emerging as world leaders in this growing field.

Eight Ways of Relating Science and Theology

Not everyone views the relation between science and religion the same. If we extend the metaphor of warfare, we can see that positions vary from pitched battle to an uneasy truce.

1 Scientism

Scientism, sometimes called 'naturalism', 'scientific materialism' or 'secular humanism', seeks war with total victory for one side. Scientism, like other '_isms', is an ideology. This one is built upon the assumption that science provides all the knowledge that we can know. There is only one reality, the natural, and science has a monopoly on the knowledge we have about nature.[3] Religion, which claims to purvey knowledge about things supernatural, provides only pseudo-knowledge – that is, false impressions about non-existent fictions.

Some decades ago, British philosopher and atheist Bertrand Russell told a BBC audience that 'what science cannot tell us, mankind cannot know'. At mid-century, astronomer Fred Hoyle argued that the Jewish and Christian religions have become outdated by modern science. He explained religious behavior as escapist, as pursued by people who seek illusory security from the mysteries of the universe.[4]

More recently, physicists Stephen Hawking and the late Carl Sagan have teamed up to assert that the cosmos is all there is or was or ever will be and to assert that there was no absolute beginning at the onset of the Big Bang. Why no beginning? Had there been an absolute beginning, then time would have an edge, and beyond this edge we could dimly glimpse a transcendent reality such as a creator God. But this is intolerable to scientism. So, by describing the

cosmos as temporally self-contained, Sagan could write confidently in the introduction to Hawking's *A Brief History of Time* about 'the absence of God' on the grounds that there is 'nothing for a Creator to do'.[5] In the warfare between science and theology, scientism demands elimination of the enemy.

2 Scientific Imperialism

Scientific Imperialism is scientism in a slightly different form. Rather than eliminating the enemy, scientific imperialism seeks to conquer the territory formally possessed by theology and claim it as its own. Whereas scientism is atheistic, scientific imperialism affirms the existence of something divine but claims knowledge of the divine comes from scientific research rather than religious revelation. 'Science has actually advanced to the point where what were formerly religious questions can be seriously tackled [by] the new physics,' writes Adelaide physicist Paul Davies.[6] What Davies does is demonstrate how the field of physics transcends itself, opening us in the direction of the divine reality. 'I belong to a group of scientists,' he writes, 'who do not subscribe to a conventional religion but nevertheless deny that the universe is a purposeless accident.... There must, it seems to me, be a deeper level of explanation. Whether one wishes to call that deeper level "God" is a matter of taste and definition.'[7]

Physicist Frank Tipler takes imperialism to the academic extreme. Claiming that quantum theory combined with Big Bang and thermodynamics can provide a better explanation than Christianity for the future resurrection of the dead, Tipler declares that theology should become a branch of physics.[8]

3 Ecclesiastical Authoritarianism

Ecclesiastical Authoritarianism is the defensive tactic followed by some in the Roman Catholic tradition who perceive science and scientism as a threat. Presuming a two-step route to truth in which natural reason is followed by divine revelation, theological dogma is here granted authority over science on the grounds that science is founded on God's revelation. In 1864, Pope Pius IX promulgated *The Syllabus of Errors*, wherein item 57 stated it to be an error to think that science and philosophy could withdraw from ecclesiastical authority. A century later, the Second Vatican Council dropped the defenses by declaring the natural sciences to be free from ecclesiastical authority and called them 'autonomous' disciplines (*Gaudium et Spes*: 59). Pope John Paul II, who has a serious interest in fostering dialogue between theology and the natural sciences, is negotiating a new peace between faith and reason.[9]

4 Scientific Creationism

Scientific Creationism, sometimes called 'creation science', is not a Protestant version of church authoritarianism, even though it is frequently so mistaken. The grandparents of today's scientific creationists were fundamentalists, to be sure, and fundamentalism appealed to biblical authority in a fashion parallel to

the Roman Catholic appeal to church authority. Yet, there is a marked difference between fundamentalist authoritarianism and contemporary creation science. Today's creation scientists are willing to argue their case in the arena of science, not biblical authority. They assume that biblical truth and scientific truth belong to the same domain. When there is a conflict between a scientific assertion and a religious assertion, we allegedly have a conflict in scientific theories. The creationists argue that the book of Genesis is itself a theory which tells us how the world was physically created: God fixed the distinct kinds (species) of organisms at the point of original creation. They did not evolve. Geological and biological facts attest to biblical truth, they argue.

With regard to theological commitments, scientific creationists typically affirm (1) the creation of the world out of nothing; (2) the insufficiency of mutation and natural selection to explain the process of evolution; (3) the stability of existing species and the impossibility of one species evolving out of another; (4) separate ancestry for apes and humans; (5) catastrophism to explain certain geological formations (for example, the flood explains why sea fossils appear on mountains); and (6) the relatively recent formation of the earth, about six to ten thousand years ago.[10]

Establishment scientists typically try to gain quick victory over creationists by dismissing them. Stephen Jay Gould, the colorful Harvard paleontologist, says the very term 'scientific creationism' is meaningless and self-contradictory.[11] Although the battle between scientific creationists and established scientists appears to be all-out war, this is not the case. The creationists, many of whom are themselves practicing scientists, see themselves as soldiers within the science army.[12]

5 *The Two-language Theory*

The two-language theory might appear to be the way to establish a truce with an enduring peace. This is because it respects the sovereign territory of both science and theology and because it is advocated by highly respected persons in both fields. Albert Einstein, remembered for his remark that 'science without religion is lame and religion without science is blind', distinguished between the language of fact and the language of value. 'Science can only ascertain what *is*, but not what *should be*,' he once told an audience at Princeton; 'religion, on the other hand, deals only with evaluations of human thought and action.' Note the use of 'only' here. Each language is *restricted* to its respective domain.

As of this writing, the current president of the American Association for the Advancement of Science, paleontologist Stephen Jay Gould, advocates the two-language view. Responding to Pope John Paul II's elocution on evolution, Gould argues that science and religion need not be in conflict because their teachings occupy different domains. Their respective *magisteria* (teaching authorities) are 'nonoverlapping'.[13]

Neo-orthodox theologian Langdon Gilkey argues for the two-language approach. Science, he says, deals only with objective or public knowing of *proximate* origins, whereas religion and its theological articulation deals with existential or personal knowing of *ultimate* origins. Science asks '*how?*' while religion asks '*why?*'[14] What Gilkey wants, of course, is for one person to be a citizen in two lands – that is, to be able to embrace both Christian faith and scientific method without conflict.[15] To speak both languages is to be bilingual, and bilingual intellectuals can work with one another in peace.

The modern two-language theory of the relation between science and theology ought not to be confused with the premodern concept of the two books. In medieval times, revelation regarding God could be read from two books, the *book of nature* and the *book of scripture*. Both science and theology could speak of things divine. Both natural revelation and special revelation pointed us in one direction: toward God.[16] The two-language theory, in contrast, points us in two different directions: either toward God or toward the world.

A problem I have with the two-language theory is that it gains peace through separation by establishing a demilitarized zone that prevents communication. In the event that a scientist might desire to speak about divine matters or that a theologian might desire to speak about the actual world created by God, the two would have to speak past one another on the assumption that shared understanding is impossible. Why begin with such an assumption? The method of hypothetical consonance makes just the opposite assumption, namely, there is but one reality and sooner or later scientists and theologians should be able to find some areas of shared understanding.

6 *Hypothetical Consonance*

Hypothetical consonance is the name I give to the frontier that seems to be emerging beyond the two-language policy. The term 'consonance', coming from the work of Ernan McMullin, indicates that we are looking for those areas where there is a correspondence between what can be said scientifically about the natural world and what the theologian understands to be God's creation.[17] 'Consonance' in the strong sense means accord, harmony. Accord or harmony might be a treasure we hope to find, but we have not found it yet. Now, we find ourselves working with consonance in a weak sense – that is, by identifying common domains of exploration. The advances in physics, especially thermodynamics and quantum theory in relation to Big Bang cosmology, have in their own way raised questions about transcendent reality. As Paul Davies has shown, the God question can be honestly asked from within scientific reasoning. Theologians and scientists may now be sharing a common subject matter, and the idea of hypothetical consonance encourages further cooperation.

Mark William Worthing at Luther Seminary in Adelaide challenges theologians to be theologically responsible by investigating what science is saying about the world, the world of which we believe God to be the creator and redeemer. 'Theology ... has the responsibility to demonstrate to what extent and in what ways Christian faith is compatible with cosmologies that may in fact prove to be an accurate description of the universe.'[18] Princeton theologian Wentzel van Huyssteen puts it this way: 'As Christians we should therefore take very seriously the theories of physics and cosmology; not to

exploit or to try to change them, but to try to find interpretations that would suggest some form of complementary consonance with the Christian viewpoint.'[19]

Hypothetical consonance asks theologians to view their discipline somewhat differently. Rather than beginning from a rigid position of inviolable truth, the term 'hypothetical' asks theologians to subject their own assertions to further investigation and possible confirmation or disconfirmation. An openness to learning something new on the part of theologians and scientists alike is essential for hypothetical consonance to move us forward. Canberra systematic theologian Stephen Pickard 'suggests a more modest and humble theological task, willing to admit uncertainty and an appropriate provisionality in the results of theological enquiry, perhaps more so than has occurred in the past'.[20]

The new book by Flinders University/Adelaide School of Divinity theologian Denis Edwards, *The God of Evolution*, presumes hypothetical consonance when putting together evolutionary biology with Christian theology. As the 'of' in the book's title indicates, *The God of Evolution* does not hold that science and faith speak separate and untranslatable languages. Quite the contrary. The scientific theory of evolution provides actual knowledge about the way in which God works in nature to achieve divine purposes: 'There is every reason for a Christian of today to embrace *both* the theological teachings of Genesis *and* the theory of evolution. But holding together the Christian view of God and the insights of evolutionary science does demand a rethinking of our theology of the trinitarian God at work in creation.'[21]

It is my judgment that, at least for the near future, the model of hypothetical consonance should lead the conversation between natural science and Christian theology. Scientists are already recognizing the limits to reductionist methods and peering into the deeper questions about the nature of nature and the significance of all that is real. Theologians are mandated to speak responsibly about the natural world we claim to be the creation of a divine creator, and natural science has demonstrated its ability to increase our knowledge and understanding of this wondrous world. If God is the creator, we should expect growth in our understanding of God as we grow in understanding of the creation. Conversely, we should expect that, if the world is a creation, it cannot be fully understood without reference to its creator.

7 *Ethical Overlap*

Ethical overlap refers to the recognized need on the part of theologians to speak to the questions of human meaning created by our industrial and technological society and, even more urgently, to the ethical challenges posed by the environmental crisis and the need to plan for the long-range future of the planet. The ecological challenge arises from the crisis-crossing forces of population overgrowth, increased industrial and agricultural production that depletes non-renewable natural resources while polluting air and soil and water, the widening split between the haves and the have-nots around the world, and the loss of a sense of responsibility for the welfare of future

generations. Modern technology is largely responsible for this ecological crisis, and theologians, along with secular moralists are struggling to gain ethical control over technological and economic forces that, if left to themselves, will drive us toward destruction.

An advocate of hypothetical consonance, I belong also to the ethical overlap camp. I believe that, at root, the ecological crisis poses a spiritual issue, namely, the crying need of world civilization for an ethical vision. An ethical vision – a vision of a just and sustainable society that lives in harmony with its environment and at peace with itself – is essential for future planning and motivating the peoples of the world to fruitful action. Ecological thinking is future thinking. Its logic takes the following form: *understanding–decision–control.* Prescinding from the scientific model, we implicitly assume that to solve the ecocrisis we need to understand the forces of destruction. Then, we need to make the decisions and take the actions that will put us in control of our future and establish a human economy that is in harmony with earth's natural ecology.

In order to bring theological resources to bear on the ecological challenge, most theologians have tried to mine the doctrine of creation for its wealth of ethical resources. It is my judgment that we need more than creation; we also need to appeal to eschatological redemption – that is, new creation. God's redeeming work is equally important when we begin with a creation that has somehow gone awry.

I believe the promise of eschatological renewal can provide a sense of direction, a vision of the coming just and sustainable society, and a motivating power that speaks relevantly to the understanding–decision–control formula. We need to combine creation with new creation. Theologians can make a genuine contribution to the public discussion if, on the basis of eschatological resources, we can project a vision of the coming new world order; that is, announce the promised kingdom of God and work from that vision backward to our present circumstance. This vision should picture our world as (a) a single, worldwide planetary society; (b) united in devotion to the will of God; (c) sustainable within the biological carrying capacity of the planet and harmonized with the principles of the ecosphere; (d) organized politically so as to preserve the just rights and voluntary contributions of all individuals; (e) organized economically so as to guarantee the basic survival needs of each person; (f) organized socially so that dignity and freedom are respected and protected in every quarter; and (g) dedicated to advancing the quality of life on behalf of future generations.[22]

8 *New Age Spirituality*

New Age spirituality is the last entry in our list of parties interested in the science–religion struggle. The key to New Age thinking is holism: the attempt to overcome modern dualisms such as the split between science and spirit, ideas and feelings, male and female, rich and poor, humanity and nature. New Age artillery is loaded with three explosive sets of ideas: (1) discoveries in twentieth-century physics, especially quantum theory; (2) acknowledgment of

the important role played by imagination in human knowing; and (3) a recognition of the ethical exigency of preserving our planet from ecological destruction.

Fritjof Capra and David Bohm, who combine Hindu mysticism with physical theory, are among the favorite New Age physicists. Bohm, for example, argues that the explicate order of things that we accept as the natural world and that is studied in laboratories is not the fundamental reality; there is under and behind it an implicate order, a realm of undivided wholeness. This wholeness, like a hologram, is fully present in each of the explicate parts. Reality, according to Bohm, is ultimately 'undivided wholeness in flowing movement'.[23] When we focus on either objective knowing or subjective feeling, we temporarily forget the unity that binds them. New Age spirituality seeks to cultivate awareness of this underlying and continually changing unity.

A recent *Christian Century* article on science and religion promulgates such holism with a pantheistic overtone. 'When I am dreaming quantum dreams,' writes Barbara Brown Taylor, 'the picture I see is more like a web of relationships – an infinite web, flung across the vastness of space like a luminous net.... God is the web ... I want to proclaim that God is the unity – the very energy, the very intelligence, the very elegance and passion that make it all go.'[24]

By adding evolutionary theory to physics and especially to Big Bang cosmology, New Age theorists find themselves constructing a grand story – a myth – regarding the history and future of the cosmos of which we human beings are an integral and conscious part. On the basis of this grand myth, New Age ethics tries to proffer a vision of the future that will guide and motivate action appropriate to solving the ecological problem. Science here provides the background not only for ethical overlap, but also for a fundamental religious revelation. Brian Swimme and Thomas Berry put it this way: 'Our new sense of the universe is itself a type of revelatory experience. Presently we are moving beyond any religious expression so far known to the human into a meta-religious age, that seems to be a new comprehensive context for all religions.... The natural world itself is the primary economic reality, the primary educator, the primary governance, the primary technologist, the primary healer, the primary presence of the sacred, the primary moral value.'[25]

Now, I happen to find the ethical vision of the New Age inspiring. But I cannot in good conscience endorse its meta-religious naturalism. I find it contrived and uncompelling. Nearly the same ecological ethic with an even stronger emphasis on social justice can be derived from Christian eschatology.

Returning to the more theoretical tie between science and theology, I earlier recommended hypothetical consonance as the most viable option for the near future. Hypothetical consonance takes us beyond the limits of the two-language theory without initially violating the integrity of either natural science or Christian theology. Where the leading scholars find themselves, to my interpretation, is with one foot in the two-language theory and the other stretched for a stride to go beyond. That stride means we need to step back into an age-old theological concern, namely, the relation of faith to reason.

Faith and Reason in Science and Theology

The key development among those scholars who either strive for consonance or are at least in partial sympathy with consonance is the attempt to demonstrate overlap between scientific and theological reasoning. Two insights guide the discussion. First, scientific reasoning depends in part on a faith component, on foundational yet unprovable assumptions. Second, theological reasoning should be recast so as to take on a hypothetical character that is subject to testing. What is a matter of some dispute, however, is whether or not theological assertions refer – that is, is theology a form of realism? Do theological statements merely give expression to the faith of a religious community or do they refer to a reality beyond themselves such as God? Theologians are asking to what extent *critical realism* in the philosophy of science should be incorporated into theological methodology.

Langdon Gilkey has long argued that science, every bit as much as theology, rests upon faith. Science must appeal to some foundational assumptions regarding the nature of reality and our apprehension of it, assumptions which themselves cannot be proved within the scope of scientific reasoning. In its own disguised fashion, science is religious or mythical. 'The activity of knowing,' he writes, 'points beyond itself to a ground of ultimacy which its own forms of discourse cannot usefully thematize, and for which religious symbolization is alone adequate.'[26] Scientific reasoning depends upon the deeply held conviction – the passion of the scientist – that the world is rational and knowable and that truth is worth pursuing. 'This is not "faith" in the strictly religious and certainly not in the Christian sense,' he observes. 'But it is a *commitment* in the sense that it is a personal act of acceptance and affirmation of an ultimate in one's life.'[27]

On the scientific side, Paul Davies acknowledges the faith dimension to science in terms of assumptions regarding rationality. Presumed here is a gnostic-style connection between the rational structure of the universe and the corresponding spark of rationality in the human mind. That human reasoning is generally reliable constitutes his 'optimistic view'.[28] Yet he acknowledges that the pursuit of scientific knowledge will not eliminate all mystery, because every chain of reasoning will eventually hit its limit and force on us the meta-scientific question of transcendence. 'Sooner or later we all have to accept something as given,' he writes, 'whether it is God, or logic, or a set of laws, or some other foundation of existence. Thus "ultimate" questions will always lie beyond the scope of empirical science.'[29]

On the issue of faith at the level of assumption, theologians and scientists, at least philosophers of science, agree. This raises a second related issue: does theology, like science, seek to explain? If so, then theology cannot restrict itself to individual or even communal subjectivity or to authoritarian methods of justification that isolate it from common human reasoning. This is what Philip Clayton argues: 'theology cannot avoid an appeal to broader canons of rational argumentation and explanatory adequacy'.[30] Clayton proceeds to argue for intersubjective criticizability and to view theology as engaged in transcommunal explanation.

If theology seeks to explain, does it also refer? This is the question of critical realism to which we now turn.

Critical Realism and Theological Reference

Wentzel van Huysteen, professor in the first chair in the United States designated for Theology and Natural Science at Princeton, believes that theological statements about God refer to God. He advocates 'critical–theological realism' and a method for justifying theories in systematic theology that parallels what we find in natural science. Justification occurs through progressive illumination offered by a theological theory, not as traditionally done by appeal to ecclesiastical or some other undisputable authority. Van Huyssteen recognizes the relativistic, contextual and metaphorical dimensions of human speech that flood all discourse, theological and scientific alike. Progress toward truth requires constructive thought, the building up of metaphors and models so as to emit growing insight.[31] And, most significantly, theological assertions refer to God. They are realistic. 'Theology,' he writes, 'given both the ultimate religious commitment of the theologian and the metaphoric nature of our religious language, is scientifically committed to a realist point of view.... Our theological theories do indeed refer to a Reality beyond and greater than ours.'[32]

On the one hand, critical realism should be contrasted with non-literalist methods such as positivism and instrumentalism, because it recognizes that theories represent the real world. On the other hand, critical realism should be contrasted also with 'naïve realism', which invokes the correspondence theory of truth to presume a literal correspondence between one's mental picture and the object to which this picture refers. Critical realism, in contrast, is non-literal while still referential. The indirectness comes from the conscious use of metaphors, models and theories. Ian Barbour notes that 'Models and theories are abstract symbol systems, which inadequately and selectively represent particular aspects of the world for specific purposes. This view preserves the scientist's realistic intent while recognizing that models and theories are imaginative human constructs. Models, on this reading, are to be taken seriously but not literally.'[33] Urging the adoption of critical realism by theologians, Arthur Peacocke maintains that 'Critical realism in theology would maintain that theological concepts and models should be regarded as partial and inadequate, but necessary and, indeed, the only ways of referring to the reality that is named as "God" and to God's relation with humanity.'[34]

Not all theological voices chime in with harmony here. Nancey Murphy recommends that theologians avoid critical realism on the grounds that it remains modern just when we need to move toward postmodern reasoning. Critical realism remains caught in three restrictive elements of the modern mind: (1) epistemological foundationalism which attempts to provide an indubitable ground for believing; (2) representational thinking with its correspondence theory of truth; and (3) excessive individualism and inadequate attention to the community. The postmodern elements she lifts up for the theological agenda are (1) a non-foundationalist epistemological holism and (2) meaning as use in language philosophy.[35] What counts for Murphy is the progressive nature of a research program, and this is a sufficient criterion for evaluating theological research regardless of its referentiality.

Theological Assertions as Hypotheses: Wolfhart Pannenberg

Would the tasks of explanation and reference make theology itself scientific? Yes, answers Munich systematic theologian Wolfhart Pannenberg. Describing theology as the science of God, he contends that each theological assertion has the logical structure of a hypothesis.[36] This makes it subject to verification against the relevant state of affairs it seeks to explain. But how can we confirm or disconfirm an assertion about God? A theologian cannot follow a method of direct verification because the existence of its object, God, is itself in dispute and because God – defined by Pannenberg as the all-determining reality – is not a reproducible finite entity. An indirect method of verification is available, however. Building in part on Karl Popper's procedures for critical verification and falsification, Pannenberg submits that we can test assertions by their implications. Assertions about a divine life and divine actions can be tested by their implications for understanding the whole of finite reality, a wholeness which is implicitly anticipated in the ordinary experience of meaning.

Because of the temporal process in which the finite world is ever-changing, the whole, which is an essential framework for any item of experience to have a determinate meaning, does not exist yet as a totality. If there is a whole at all, then it must be future. So it can only be imagined, anticipated. As anticipation, the very positing of a temporal whole involves an element of hypothesis. Even the reality of God fits into this class. The reality of God is present to us now only in subjective anticipation of the totality of finite reality, in a conceptual model of the whole of meaning that we presuppose in all particular experience. Christians think of the whole temporally and eschatologically. The theological idea of the eschatological kingdom of God that arises from our historic religious tradition is subject to future confirmation or refutation by what happens. It is this openness to confirmation that makes theological assertions hypothetical and, hence, scientific.

The anticipation of wholeness of meaning within common human experience is the key that makes Pannenberg's method work. We anticipate a wholeness of meaning that is not yet fully present, a wholeness which we hypothesize will come in the future as the gift of an eschatological act of the one God. The *direct confirmation* of this hypothesis is dependent upon the actual coming of that eschatological wholeness. In the meantime, while we await the eschatological fulfillment, our faith in the future takes the form of a hypothesis that can gain *indirect confirmation* by the increased intelligibility it offers to our understanding of our experience of finite reality. If in fact God is the all-determining reality, then everything else we study, including the natural world, must eventually be shown to be determined by this reality. The very raising of the hypothesis of God as the all-determining one can be evaluated positively if

it increases the intelligibility of the natural world we study through scientific disciplines.[37] It is this task of increasing the intelligibility of the natural world by considering it in relation to God that leads Pannenberg to engage in dialogue with scientists and to construct a theology of nature.

'Science and Religion' v. 'Science and Theology': Thomas F. Torrance

Pannenberg believes theology can be scientific if it makes hypotheses and seeks to confirm them. In complementary contrast, Thomas Torrance, who taught Christian Dogmatics at the University of Edinburgh from 1952 to 1979, argues that it is the objectivity of theology that makes it scientific.

The first and salient legacy of the Torrance approach is a key distinction: 'Science and Religion' versus 'Science and Theology'. These two labels are not the same. Religion has to do with human consciousness and human behavior. Theology has to do with God. 'Whenever religion is substituted in the place of God, the fact that in religion we are concerned with the behaviour of *religious people*, sooner or later means the substitution of humanity in the place of religion . . . '.[38] Torrance clearly prefers to take up the distinctively theological task, defining theology as a science. He describes theology (or a philosophy of theology) as a 'meta-science of our direct cognitive relation with God. Science and meta-science are required not because God is a problem but because *we* are . . . . It is because *our* relations with God have become problematic that we must have a scientific theology'.[39] One can see clearly here the influence of Karl Barth in getting beyond religious consciousness as the object of theology and allowing our consciousness to be shaped by the true object of theology, God. 'Scientific theology is active engagement in that cognitive relation to God in obedience to the demands of His reality and self-giving.'[40]

Torrance stresses that authentic inquiry, both scientific inquiry and theological inquiry, attend to what is, to what is actual, to what is real; this means that we should guard against superimposing upon reality an *a priori* or idealistic scheme. To this end, we allow our inquiry to be guided by its object, by the reality of the object under study. The transition from the Newtonian world-view to the Einstein revolution could take place only when science was authentic, only when it let nature tell us what nature is like.

In stressing this point, Torrance elegantly moves natural theology from its previous position of prolegomena into positive theology proper. This move parallels Einstein's treatment of geometry. The Euclidian geometry inherited with Newtonian physics provided a context for inquiry that presupposed absolute mathematical space and time with bodies in motion. For Einstein, this constituted an idealized presupposition detached from nature as he was studying it. Einstein's revolution in the theory of relativity consisted of placing geometry into the material content of physics. Rather than treating geometry as an idealized framework, Einstein brought it into the midst of physics where it became a natural science indissolubly united to physics.

Torrance wants to learn from Einstein's example. He puts natural theology where Einstein had put geometry. 'So it is with natural theology: brought within the embrace of positive theology and developed as a complex of rational structures arising in our actual knowledge of God it becomes "natural" in a new way, natural to its proper object, God in self-revealing interaction with us in space and time. Natural theology then constitutes the epistemological geometry, as it were, within the fabric of revealed theology.'[41] By making this post-Barthian move, Torrance denies natural theology any independent status while making it serve as an instrument for unfolding and expressing the knowledge content of Christian theology.

Authentic theology, then, attends to its object, God. It listens to what the Word of God tells us. This form of objectivity – listening to the object of inquiry – makes both science and theology scientific.

> Theology is the unique science devoted to knowledge of God, differing from other sciences by the uniqueness of its object [God] which can be apprehended only on its own terms and from within the actual situation it has created in our existence in making itself known . . . . Yet as a *science* theology is only a human endeavour in quest of the truth, in which we seek to apprehend God as far as we may, to understand what we apprehend, and to speak clearly and carefully about what we understand. It takes place only within the environment of the special sciences and only within the bounds of human learning and reasoning where critical judgment and rigorous testing are required, but where in faithfulness to its ultimate term of reference beyond itself to God it cannot attempt to justify itself on the grounds occupied by the other sciences or within their frames of interpretation.[42]

Torrance recognizes the finite and perspectival limits of human knowing as it operates in theology and the other sciences, and it is just this perspectival limit that mandates that authentic inquiry attend to its object and learn from its object.

Departing from Barth, for whom theology could be methodologically isolated from other disciplines, Torrance argues that theology should engage the natural sciences in conversation. Torrance affirms *creatio ex nihilo*, noting that the divine transcendence implied here renders the created world contingent. The contingency of the world requires that we study the world directly to unlock its secrets. No idealistic shortcuts or revelations about God can substitute for empirical research. This functions as a sort of theological blessing upon the scientific enterprise.

Torrance wants the theologian to broaden the scope of attention, to get beyond anthropology to include nature around and in us. Theology has been suffering from tunnel vision, he complains, wherein we have limited theology to the relationship between God and the human race. Theology cannot be restricted to the relationship of God to humanity. 'Theology has to do with the unlimited reality of God in his relations with the universe of all time and space.'[43] Hence the sciences broaden our knowledge of God's creation and provide an understanding of the arena within which incarnation and resurrection take place.

This enlargement of the scope of theology to include all space and time provides the framework for specifying just how God can be an object of

inquiry and how knowledge of God can be objective. Torrance is a trinitarian theologian, and the finite objectivity of God incarnate grounds the objectivity of theology.[44]

> The framework of objective meaning which concerns the theologian here is bound up with the incarnation of the Son of God to be one with us in our physical human existence within the world of space and time in such a way that through his vicarious life and passion he might redeem human being and creatively reground it in the very life of God himself, and therefore it is also bound up with the resurrection of Jesus Christ in body, or the physical reality of his human existence among us, for it is in the resurrection that God's incarnate and redeeming purpose for us is brought to its triumphant fulfillment.[45]

One of the difficulties any Barthian theologian confronts when engaging in dialogue with the natural sciences is the apparent self-referentiality of the theological circle. The existence of the object of theological inquiry, God, is just what is in dispute in the modern world. To presuppose its truth and then contend that this produces knowledge seems to beg the question. Torrance is aware of the difficulty. He defends his method with a *tu quoque* argument, noting that all theories are circular and striving to establish themselves through coherence because they cannot be derived or justified on any grounds other than what they themselves constitute. In this regard, theology is no worse off than any other discipline.[46]

Science and Systematic Theology: Arthur Peacocke

For good or ill, it seems that within the subfields of theology one group, the systematic theologians, have taken the lead in developing a working relationship with the natural sciences. Biblical studies has long employed the investigative techniques of archaeology, to be sure, and Historical Theology and Ethics are coming to rely more and more on methods developed by the social sciences. But, it has been the systematic theologians who have carefully examined scientific methods, adopted some into theological methodology, and proceeded in certain cases to incorporate knowledge gained from natural science into the formulation of doctrinal beliefs.

Significant here is the creative work of Arthur Peacocke. A biochemist turned theologian, Peacocke is former Dean of Clare College at Cambridge, is retired from directing the Ian Ramsey Centre at Oxford, and is Warden Emeritus of the Society of Ordained Scientists. 'Theology needs to be consonant and coherent with, though far from being derived from, scientific perspectives on the world,' he asserts.[47] The task for theology is clear: to rethink religious conceptualizations in light of the perspective on the world afforded by the sciences.

This rethinking leads to questions about God. God is mysterious, affirms Peacocke. Natural theology paints a picture of an ineffable and transcendent God beyond human comprehension. The special revelation of God experienced

in the person of Jesus Christ only enhances the mystery of the divine. Yet, mystery is by no means confined to theology. Twentieth-century science is characterized by a new appreciation of the mystery of existence. Such things as indeterminacy and vacuum fluctuations in quantum physics have increased our knowledge while at the same time they have humbled our previous *hubris* for assuming causal explanations would be right around the corner. The foundation of physical reality is more elusive than once thought. 'So the mystery-of-existence question becomes even more pressing in the light of the cosmic panorama disclosed by the natural sciences.'[48] Also mysterious is human personhood, arising as it does from the biological sphere to that of consciousness and then becoming itself a top-down cause. Peacocke believes that 'this recognition of an ultimate ineffability in the nature of the divine parallels that of our ultimate inability to say what even things and persons are in themselves'.[49]

Peacocke's rethinking of theological conceptions in light of natural science is leading him to assert certain things about God: beyond the eternity of the divine *being*, God is engaged in temporal *becoming*; beyond *creatio ex nihilo*, God is engaged in *creatio continua*; God creates and dynamically 'lets be'; God is the ultimate source and ground of both necessity and chance; God has a self-limited omnipotence and omniscience, thereby permitting necessity and chance in the history of nature; the divine act of self-limitation for the good of the creation warrants our saying that *God is love*. These reconceptualizations lead finally to a theopaschism: 'God suffers in, with and under the creative processes of the world.'[50]

Some interpreters of Peacocke assign the label 'temporal critical realism' to his work. Perhaps this is appropriate, for Peacocke writes, 'In giving being to entities, structures and processes *in* time, God cannot have a *static* relation to that time which is created with them. Hence we have to speak of a dynamic divine "becoming" as well as of the divine "being".'[51]

Bottoms-up Systematics: John Polkinghorne

Peacocke is a hybrid – that is, he is trained in both science and theology. Another hybrid is mathematician–physicist turned theologian John Polkinghorne, now president of Queens' College, Cambridge. Polkinghorne pursues systematic theology with what he calls a 'bottom-up' method. The *bottoms* with which he begins are scientific data regarding the natural world, historical data regarding the biography of Jesus, the church's threefold encounter with the economic Trinity, and such. The *up* with which he concludes is a high degree of confidence regarding the fundamental commitments of the Christian faith, commitments that are completely compatible with the truths pursued in the field of science.[52]

Steadfast in affirming that epistemology models ontology, Polkinghorne begins methodologically with faith and reason. Faith is not merely a polite expression for unsubstantiated assertion or an excuse for believing in God as an irrational act. Rather, faith and reason belong together. Both reflect the

quest for truth. Truth seeking is something shared by scientists and theologians alike. 'Although faith goes beyond what is logically demonstrable,' he writes, 'yet it is capable of rational motivation. Christians do not have to close their minds, nor are they faced with the dilemma of having to choose between ancient faith and modern knowledge. They can hold both together.'[53]

Polkinghorne is committed to *consonance*: theological reflection on creation must be consonant with what science says about Big Bang and evolution. This by no means requires that theological assertions be reducible to scientific assertions. The scientific world-view is itself subject to interrogation and expansion, and this is pursued through metaphysics.

None of us can do without metaphysics, he observes, and then admonishes us to do metaphysics deliberately. Rejecting Cartesian dualism in favor of what he calls 'dual-aspect monism', Polkinghorne opens biology to the existence of supraphysical consciousness or spirit; and he opens physics to a reality that transcends the world of the Big Bang and the evolution of conscious life.[54] At this point extrapolation and speculation from a scientific basis cease. Polkinghorne then turns to orthodox Christian commitments – such as a theistic understanding of God and *creatio ex nihilo* – and simply defends them against competing positions.

For example, he distinguishes his position from the deism opposed by Stephen Hawking and other physicists when discussing the onset of the Big Bang with its possible edge of time at the beginning, which implies that creation becomes limited to a single act at the beginning. From then on, God is presumed to let nature take its evolutionary course. But Polkinghorne is a theist who believes in an active God, so he combines *creatio ex nihilo* with *creatio continua* to emphasize God's continuing involvement in nature. Polkinghorne's active God is omnipotent, but is by no means a tyrant. God's power has been withheld to make room for freedom within nature. God still acts in nature without obviating this freedom. 'One is trying to steer a path between the unrelaxing grip of a Cosmic Tyrant and the impotence or indifference of a Deistic Spectator.'[55]

Then, looking in the other direction, Polkinghorne distinguishes his position from the panentheism of process theology, because the latter fails to provide sufficient grounds for hope. The God of Alfred North Whitehead, the leading process philospopher of the 20th century, can very well share our suffering, but there is no eschatological guarantee here that evil will be overcome. Being remembered by the consequent nature of God is unsatisfying to Polkinghorne. 'I do not want to be just a fly in the amber of divine remembrance,' he writes, 'I look forward to a destiny and a continuing life beyond death. To put it bluntly, the God of process theology does not seem to be the God who raised Jesus from the dead.'[56]

I wonder if this defense of theism, as clear and forceful as it is, actually needs the discussion of science. It seems to me that this classic debate between deists, theists and panentheists is only occasioned by issues rising out of Big Bang physics. The physics itself does not actually influence the direction let alone determine the destination of the debate as we find it in Polkinghorne.

Polkinghorne rightly defines his position sharply against panentheistic colleagues in the field such as Arthur Peacocke and Ian Barbour. The strength of Peacocke and Barbour is perhaps that they wrestle more thoroughly with the actual scientific ideas and seek a fuller integration with theological ideas. The strength of Polkinghorne is his confidence that the Christian faith, when subjected to the same rational scrutiny that science exacts upon its data and theories, exhibits an honest pursuit of truth accompanied by a confidence in its rational motivation.

Physical Cosmology and Divine Action: Robert John Russell

On the American side of the Atlantic, we find Robert John Russell, a hybrid physicist and systematic theologian, directing the program he founded in 1981: The Center for Theology and the Natural Sciences at the Graduate Theological Union in Berkeley.[57] Methodologically, Russell belongs to the consonance school, but in his own way he emphasizes a dialectic between consonance and dissonance. Science and theology can, at points, take different trajectories, and dissonance must be acknowledged. Like Polkinghorne, Russell is clear that scientific prognostications regarding the future of the cosmos do not square with Christian eschatology. A projected heat death due to entropy does not square with the promise of resurrection and new creation. Here is dissonance that needs to be acknowledged. Inspired by the work of his former student, Nancey Murphy, who employs the philosophy of Imre Lakatos for theological purposes, Russell seeks to embed the consonance–dissonance dialectic more tightly into a theological method that sees itself as a progressive research programme.[58]

In careful conversation with physical cosmologists and with theologians such as Ian Barbour and Willem Drees, Russell has pressed for consonance on understandings of the origin of the universe found in Big Bang cosmology and the Christian concept of creation.[59] The orienting question is this: is the Christian doctrine of *creatio ex nihilo* consonant with the Big Bang? Many answers have been given, all unsatisfying to Russell. The two-language answer is 'no', because this school believes in principle that no scientific picture of the universe's origin has any conceptual relevance for theology. It precludes looking for consonance at the outset. An alternative answer, a semi-literalist answer, would be: 'yes, they are consonant because the scientific discovery of a beginning to the universe corroborates the Christian view that the creation had a beginning boundary, before which there was nothing'. Two things make this unsatisfying as well. First, current conversations regarding quantum theory make it premature to say that the scientific consensus is that the universe – at least the original singularity – had an absolute beginning. Second, the force of the *creatio ex nihilo* idea is that the world is ontologically dependent upon God and this could be the case even if there were no beginning boundary.

Russell feels the need to find his own answer. Following the Lakatos-Murphy distinction between the inner core commitment and the outer belt of auxiliary hypotheses in a research program, he posits the following as core

creatio ex nihilo means ontological dependence. Then, he adumbrates three auxiliary hypotheses: (1) ontological dependence entails finitude; (2) finitude includes temporal finitude; and (3) temporal finitude entails past finitude – that is, going backwards in finite time must take us to a beginning, a $t = 0$ point. This fits with what we know from Big Bang cosmology in which the data of astrophysics, the theory of general relativity, and other factors point us to an initial singularity, $t = 0$. That this singularity may have a quantum life of its own does not stop Russell from tendering a modest conclusion: the empirical origination described by $t = 0$ in Big Bang cosmology tends to confirm what is entailed in this theory's core, namely, *creatio ex nihilo* means ontological dependence. This is not a proof, but it is a partial confirmation.[60]

Russell's contribution to the internal theological debate is the distinction he draws between finitude and boundedness. Traditionally, theologians have identified the two. But they are not identical. Ontological dependence upon God requires that the world be finite but not necessarily bounded. The initial singularity may have had a quantum life of its own and, hence, no temporal boundaries; yet, we can still say that the world has a beginning and that it is finite in time. Big Bang cosmology, even in its quantum form, becomes a character witness, even if not an eye witness, to the creation of the world.

The Created Co-creator: Philip Hefner

Like Russell, Philip Hefner picks up on the Lakatos–Murphy methodology with its core–auxiliary distinction. He puts God in the hard core, 'that to which all terrestrial and cosmic data are related'.[61] He adds seven auxiliary hypotheses, which I will not enumerate here. He believes that the test of theology is its explanatory adequacy, that it is subject to falsification by experience and that its relative success should be measured by its fruitfulness. 'What is at stake in the falsification of theological theories is not whether they can prove the existence of God,' he writes, 'but rather whether, with the help of auxiliary hypotheses, they lead to interpretations of the world and of our experience in the world that are empirically credible and fruitful – that is, productive of new insights and research.'[62]

Hefner is professor emeritus of systematic theology at the Lutheran School of Theology at Chicago, editor of the journal *Zygon* and director of the Chicago Center for Science and Religion. His career work in the field has been devoted less to physical cosmology and more to rapprochement between theology and the life sciences, especially evolutionary theory. He has sought to develop an anthropology and even a Christology in what he calls a biocultural evolutionary scheme. His is a grand vision, and at the focal center of this vision is the concept of the human being as the *created co-creator*. A basic element embedded within the core rather than located in an outer auxiliary hypothesis, the concept of the created co-creator is Hefner's central contribution to the Theology and Natural Science enterprise. He writes, 'Human beings are God's created co-creators whose purpose is to be the agency, acting in freedom, to birth the future that is most wholesome for the nature that has birthed us – the nature that is not only our own genetic heritage, but also the entire human community and the evolutionary and ecological reality in which and to which we belong. Exercising this agency is said to be God's will for humans.'[63]

Hefner has been criticized for advocating human hubris, for placing humanity on a level with the divine and overestimating the human potential for creativity. Such a criticism might apply to New Age thought, but not to Hefner. Hefner is clear that we human beings are creatures, brought here by God the creator even if God employed evolution to create us. This is what he means by *created* co-creator. Nevertheless, when explicating the biblical concept of the *imago dei*, Hefner wants to include creativity in the divine image and exhort us ethically to take responsibility for creating a future that is more human, more just and more loving.

Conclusion: Seeing Cosmos as Creation

We in the Christian tradition are used to speaking glibly of the natural world as God's creation. On what basis do we do this? It is not immediately obvious from observing the natural realm that it is the product of a divine hand or the object of divine care. Since the Enlightenment, we in the modern scientific world have been assuming that no footprints of the divine can be discerned in the sands of the natural world. Western science assumes that, if we study natural processes with the intention of learning the laws by which nature operates, what we will end up with is just a handful of natural laws. If we study natural processes with the intention of wondering about the magnificent mysteries that surround us, we will end up where we started, namely, with an imagination full of spectacular puzzles. If we study nature for her beauty, we will see beauty. If we study nature to see her violence, we will see her as did Tennyson, blood 'red in tooth and claw'. Nature, we have been assuming for a century or so now, does not seem to take the initiative to disclose her ultimate foundation or even her existential meaning. What natural revelation reveals is simply nature, not God. If we want to know more, we have to ask more questions. And we have to go beyond our natural relationship with nature to find the answers.

Christian theologians, seeing the limits to natural revelation in a modern world replete with naturalism, find they need to go to the historical events of the death and resurrection of Jesus Christ, the events that stand at the heart and center of God's special revelation. Good Friday and Easter do not reveal that God is the world's creator for the first time, of course. But these events do confirm what had already been suspected in ancient Israel, namely, that the creation of the world was the necessary first act in God's continuing drama of salvation. The world in which we live is not merely a conglomeration of natural laws or puzzles; it is not merely the realm of beauty or violence. The cosmos exists because it plays a part in the divine scenario of redemption. It is on the basis of what we know about the God who raised Jesus from the dead that St Paul can perceive how creation has been 'subjected to futility', that it 'has been groaning in travail' and that God has furthermore 'subjected it in hope

because it 'will be set free from its bondage to decay and obtain the glorious liberty of the children of God' (Rom.8:18–25).

Special experiences of God reveal special knowledge. We need to know, or at least need to hypothesize, that there is a God with divine intentions before we can see clearly that the world around and in us is in fact a creation. It is primarily on the strength of Israel's experience with the liberating God of the Exodus that the Old Testament writers could depict the world as God's creative handiwork. It is on the strength of our experience with the incarnate Lord that Christians in today's world can say that 'God so loved the world . . .' (John 3:16). The New Testament promise of an eschatological new creation tells us something essential about the present creation. Theologically, it is God's promised kingdom that determines creation, and creation is the promise of the kingdom. Whether we interpret nature through the symbol of the Exodus, the incarnation, the kingdom or some other similar religious symbol, we find that we are dependent upon some form of revelation of God's purposes if we are to put nature into proper theological perspective – that is, if we are to think of nature as a creation.

So, curiously enough, we might consider the possibility of a reversal in natural theology. Traditionally, the aim of natural theology has been to ask what our study of nature can contribute to our knowledge of God. But might it work in reverse? Might we ask what our knowledge of God can contribute to our knowledge of nature? To know that God is the creator is to know that the world in which we live and move and have our being is *creation*.

We may not have to choose between the two methods, of course. We could begin with nature and then ask about God or we could begin with what we think we know about God and then ask how this influences what we think about nature. Or we could do both. Both should be on the agenda of those working in the field of Theology and Natural Science.

Notes

1 A.D. White, *A History of the Warfare of Science with Theology*, 2 volumes (New York: Dover, 1896; 1960).

2 The line-up of contending forces I offer here is revised from that sketched previously in the Preface to my *Cosmos as Creation* (Nashville: Abingdon Press, 1989), 13–17. It is also a more nuanced line-up compared to the one offered by Ian Barbour in his Gifford Lectures, *Religion in an Age of Science* (San Francisco: Harper, 1990), 3–30, wherein he identifies four ways: conflict, independence, dialogue and integration. My categories of scientism and church authoritarianism fit his conflict category, and the two-language theory is a model of independence in both schemes. Yet, Barbour's notions of dialogue and integration lack the nuance that I believe is operative under the notion of consonance. Consonance involves dialogue, to be sure, but it acknowledges that integration may be only a hope and not an achievement. Also, Barbour thinks of scientific creationism in terms of 'biblical literalism' and thereby places it in the conflict category, overlooking the fact that the creationists think of themselves as sharing a common domain with science; they see themselves in conflict with scientism but not with science itself. John Haught offers up an aliterative four-unit typology – conflict, contrast, contact and confirmation – in his *Science and Religion* (New York: Paulist, 1995). Mark Richardson offers us a three-part typology: (1) integration, typified by the work of Lionel Thornton, William Temple, Austin Farrar, Arthur Peacocke and John Polkinghorne; (2) romantic, typified by poets Whitman or Wordsworth and by contemporary New Age figures such as Briane Swimme, Thomas Berry and Matthew Fox; and (3) scientific constraint, wherein one speaks univocally about the natural and transcendent worlds, typified by Paul Davies, Freman Dyson, Stephen Hawking and Frank Tipler. See Mark Richardson, 'Research Fellows Report', *CTNS Bulletin*, 14:3 (Summer 1994), 24–5. Philip Hefner cuts the pie six ways: (1) modern option of translating religious wisdom into scientific concepts; (2) postmodern/New Age option of constructing new science-based myths; (3) critical post-Enlightenment option of expressing truth at the obscure margin of science; (4) postmodern constructivist option of fashioning a new metaphysics for scientific knowledge; (5) constructivist traditional option of interpreting science in dynamic traditional concepts; and (6) Christian evangelical option of reaffirming the rationality of traditional belief. See Philip Hefner, 'Science and Religion and the Search for Meaning', *Zygon*, vol. 1 (1996), 307–21.

3 Langdon Gilkey, *Nature, Reality, and the Sacred: The Nexus of Science and Religion* (Minneapolis: Fortress, 1993), 14.

4 Fred Hoyle, *The Nature of the Universe* (New York: Mentor, 1950), 125.

5 Stephen Hawking, *A Brief History of Time* (New York: Bantam, 1988), 136; see Carl Sagan, *Cosmos* (New York: Random House, 1980). Co-discoverer of the double helix structure of DNA, Francis Crick reduces what religious people used to believe to be the disembodied soul to 'nothing but a pack of neurons'. All of our joys and sorrows, our memories and ambitions, our sense of personal identity and free will 'are in fact no more than the behavior of a vast assembly of nerve cells and their associated molecules' (*The Astonishing Hypothesis: The Scientific Search for the Soul*, New York: Charles Scribner's Sons, 1994, 3). For aggressive anti-religious secular humanism, see Paul Kurtz, *The Transcendental Temptation* (Buffalo: Prometheus, 1985) and the journal published by the Committee for the Scientific Investigation of Claims of the Paranormal, *The Skeptical Inquirer*.

6 Paul Davies, *God and the New Physics* (New York: Simon & Schuster, Touchstone, 1983), ix.

7 Paul Davies, *The Mind of God* (New York: Simon & Schuster, 1992), 16. In reviewing Davies' new book, *The Fifth Miracle: The Search for the Origin and Meaning of Life* (New York: Simon & Schuster, 1999), Philip Hefner alerts us to the manner in which Davies challenges science to go beyond its current limits: '*The Fifth Miracle* has an important subtext, which presses the claim: the current understanding of nature's laws is insufficient to understand the origin of life. Religious people have perennially perceived such insufficiencies as occasions to invoke the action of God' ('Mysterious Beginnings', *Christian Century*, 116:17, 522–623 (2–9 June 1999, 622). Davies does not invoke a religious God-of-the-gaps to fill the insufficiency, of course, but rather presses science to expand to fill this gap with a fuller understanding of nature.

8 Frank Tipler, *The Physics of Immortality* (New York: Doubleday, 1994), ix, 10, 17, 247. Tipler borrows some eschatological theology from Wolfhart Pannenberg and places it within the scientific eschatology of physicist Freeman Dyson, *Infinite in All Directions* (New York: Harper, 1988).

9 *John Paul II on Science and Religion: Reflections on the New View from Rome*, ed. by Robert John Russell, William R. Stoeger and George V. Coyne (Notre Dame:

University of Notre Dame Press, and Vatican City State: Vatican Observatory Publications, 1990). In October 1992, the pope completed a 13-year study of the Galileo affair, proclaiming that the church erred in condemning the atronomer for disobeying orders regarding the teaching of Copernicus' heliocentric theory of the universe. John Paul II described Galileo as 'a sincere believer' who was 'more perceptive [in the interpretation of Scripture] than the theologians who opposed him'. Because in the myths of scientism Galileo is touted as a martyr for truth over against the narrow-mindedness of theology, Owen Gingerich took the occasion to write to clear up the facts. One noteworthy fact is that Galileo was never condemned for heresy, only disobedience: 'How Galileo Changed the Rules of Science', *Sky and Telescope*, 85:3 (March 1993), 32–6.

10 See Duane T. Gish, *Evolution: The Fossils Say No!* (San Diego: Creation-Life Publishers, 1973) and Roger E. Timm, 'Scientific Creationism and Biblical Theology', in Peters, *Cosmos as Creation*, 247–64.

11 Stephen Jay Gould, *Hens Teeth and Horses' Toes: Reflections on Natural History* (New York: Norton, 1983), 254.

12 One could describe the war as a battle between atheistic science and theistic science. Langdon Gilkey suggests that scientism (what he calls 'scientific positivism') goes beyond the limits of science to propound an atheistic cosmology, and this initiates the reaction that results in scientific creationism. See Gilkey, *Nature, Reality, and the Sacred*, 55.

13 Stephen Jay Gould, 'Nonoverlapping Magisteria', *Natural History*, 106 (March 1997), 16–22.

14 Langdon Gilkey, *Creationism on Trial* (San Francisco: Harper, 1985), 49–52, 108–13.

15 In his more recent works, Gilkey has pressed for a closer relationship – a mutual dependence – between science and religion. Gilkey attacks scientism (what he calls 'naturalism' or 'scientific positivism') when it depicts nature as valueless, determined and void of the sacred, on the grounds that these are suprascientific or philosophical judgments that go beyond science itself. Science, therefore, must be supplemented by philosophy and religion if we are to understand reality fully (*Nature, Reality, and the Sacred*, 3, 11, 75, 111, 129).

16 The 'two books' approach is embraced today by the organization, Reasons to Believe, a publishing house that 'examines how the facts of nature and the truths of the Bible give each of us a reason to believe' (Reasons to Believe, P.O. Box 5978, Pasadena CA 91117, fax 818/852-0178).

17 Ernan McMullin, 'How Should Cosmology Relate to Theology?', in *The Sciences and Theology in the Twentieth Century*, ed. by Arthur Peacocke (Notre Dame: University of Notre Dame Press, 1981), 39. See Peters, *Cosmos as Creation*, 13–17.

18 Mark William Worthing, *God, Creation, and Contemporary Physics* (Minneapolis: Fortress Press, 1996), 193.

19 Wentzel van Huyssteen, *Duet or Duel? Theology and Science in a Postmodern World* (Harrisburg, Pennsylvania: Trinity Press International, 1998), 78.

20 Stephen Pickard, '"Unable to See the Wood for the Trees", John Locke and the Fate of Systematic Theology', in *The Task of Theology Today*, ed. by Victor Pfitzner and Hilary Regan (Adelaide: Open Book Publishers, 1998), 145.

21 Denis Edwards, *The God of Evolution* (New York: Paulist, 1999), 13.

22 See Ted Peters, *GOD – the World's Future: Systematic Theology for a Postmodern Era* (Minneapolis: Fortress, 1992), chapter 12; *Futures – Human and Divine* (Atlanta: John Knox Press, 1978).

23 David Bohm, *Wholeness and the Implicate Order* (London: Routledge and Kegan Paul, 1980), 11. See Fritjof Capra, *The Tao of Physics* (New York: Bantam, 1977);

Ted Peters, *The Cosmic Self: A Penetrating Look at Today's New Age Movements* (San Francisco: Harper, 1991), chapter four.

24 Barbara Brown Taylor, 'Physics and Faith: The Luminous Web', *Christian Century*, 116:17, 612–19 (2–9 June 1999), 619.

25 Brian Swimme and Thomas Berry, *The Universe Story* (San Francisco: Harper, 1992), 255. A variant would be the team work of physicist Joel R. Primack and musician Nancy Ellen Abrams, who are trying to construct a myth out of Big Bang inflationary cosmology and medieval Jewish Kabbalah, not because the myth would be true but because our culture needs a value-orienting cosmology ('In the Beginning... Quantum Cosmology and Kabbalah', *Tikkun*, 10:1 (January–February 1995), 66–73.

26 Langdon Gilkey, *Religion and the Scientific Future* (San Francisco: Harper, 1970), 41.

27 Ibid., 50.

28 Paul Davies, *The Mind of God* (New York: Simon & Schuster, 1992), 24; see also 232.

29 Ibid., 15. See Paul Davies, *Are We Alone?* (London and New York: Harper Collins, Basic Books, 1995).

30 Philip Clayton, *Explanation from Physics to Theology* (New Haven and London: Yale, 1989), 13; see Peters, *GOD – The World's Future*, 74–6.

31 The criterion for evaluating the progressive strength of a theory is fertility, and this constitutes the chief argument in behalf of critical realism for Ernan McMullin, 'A Case for Scientific Realism', in *Scientific Realism*, ed. by Jarret Leplin (Berkeley: University of California, 1984), 26. See Arthur Peacocke, *Intimations of Reality: Critical Realism in Science and Religion* (Notre Dame: University of Notre Dame, 1984).

32 Wentzel van Huyssteen, *Theology and the Justification of Faith* (Grand Rapids: Eerdmans, 1989), 162–3. 'I advocate a critical realism,' writes Ian Barbour, 'holding that both communities [scientific and religious communities] make cognitive claims about realities beyond the human world' (*Religion in an Age of Science*, 16).

33 Barbour, *Religion in an Age of Science*, 43; see Ian Barbour, *Myths, Models, and Paradigms* (San Francisco: Harper, 1974), 38; Sallie McFague, *Metaphorical Theology* (Minneapolis: Fortress, 1982), 133–4.

34 Arthur Peacocke, *Theology for a Scientific Age* (Oxford: Basil Blackwell, 1990, and Minneapolis: Fortress, enlarged edn, 1993), 14.

35 Nancey C. Murphy, 'Relating Theology and Science in a Postmodern Age', *CTNS Bulletin*, 7:4 (Autumn 1987), 1–10; see her Templeton Book Prize-winning work, *Theology in an Age of Scientific Reasoning* (Ithaca: Cornell, 1990).

36 Wolfhart Pannenberg, *Theology and the Philosophy of Science* (Louisville: Westminster/John Knox 1976); *Systematic Theology*, 3 volumes (Grand Rapids: Eerdmans, 1991–6).

37 See Wolfhart Pannenberg, *Toward a Theology of Nature*, ed. by Ted Peters (Louisville: Westminster/John Knox, 1993), chapter one. Similarly, John Haught expands on consonance with two nuanced categories, contact and confirmation. As a gesture of confirmation he contends that the theologian can contribute to the scientific apprehension of natural reality ('The theological notion that the world was created – and is therefore neither necessary nor eternal – gives a stature to empirical science that other ways of looking at the world do not', *Science and Religion*, 63).

38 Thomas F. Torrance, *Theological Science* (Oxford: Oxford University Press, 1969), iv–v.
39 Ibid., v.
40 Ibid., v.
41 Thomas F. Torrance, *Reality and Scientific Theology* (Edinburgh: Scottish Academic Press, 1985), 39. Karl Barth is reported to have granted full agreement to this new place for natural theology. See Thomas F. Torrance, *Space, Time and Resurrection* (Grand Rapids: Eerdmans, 1976), ix–xiii.
42 Torrance, *Theological Science*, 281–2.
43 Torrance, *Reality and Scientific Theology*, 67.
44 Thomas F. Torrance, *Space, Time and Incarnation* (Oxford: Oxford University Press, 1969).
45 Torrance, *Space, Time and Resurrection*, 13.
46 Ibid., 15. Wolfhart Pannenberg would fear that such a *tu quoque* ('you also,' says Brutus to Caesar) might become a rational excuse for an irrational commitment: *Theology and the Philosophy of Science*, 45.
47 Peacocke, *Theology for a Scientific Age*, x.
48 Ibid., 101.
49 Ibid., 102.
50 Ibid., 126.
51 Ibid., 184. Peacocke's early masterwork of 1979, *Creation and the World of Science* (Oxford: Clarendon, 1979), is organized somewhat like a systematic theology. Yet there the scientific agenda drove the project. More recently, in *Theology for a Scientific Age*, the theological agenda has taken the driver's seat. Distinctively theological commitments are being rethought in light of scientific apprehensions of nature.
52 John Polkinghorne, *The Faith of a Physicist* (Princeton: Princeton University Press, 1994), 193.
53 Ibid., 5.
54 Ibid., 21.
55 Ibid., 80.
56 Ibid., 68.
57 The Center for Theology and the Natural Sciences (CTNS) at 2400 Ridge Road, Berkeley CA 94709 is one of many active research and professional organizations pursuing science–theology dialogue. Philip Hefner directs the Chicago Center for Science and Religion at the Lutheran School of Technology at Chicago, 1100 E. 55th Street, Chicago, IL 60615. The annual Star Island conferences are sponsored by the Institute on Religion in an Age of Science (IRAS) headed by astronomer Ursula Goodenough of St. Louis. The American Scientific Affiliation (ASA) with Donald Munro as executive director is made up of scientists with evangelical Christian concerns and can be contacted at P.O. Box 668, Ipswich, MA 10938-0668. The Archbishop of York presides over the Science and Religion Forum, St Alban's Vicarage, Mercer Avenue, Coventry, CV2 4PQ, England. The European Society for the Study of Science and Theology (ESSSAT) is headed by Willem B. Drees, Högseröds Prästgard, S-240 33, Löberöd, Sweden, Fax +46-46-52975. Kevin Sharpe of the Institute on Religion in an Age of Science, 65 Hoit Road, Concord, NH 03301-1810 publishes an informative newsletter, *Science and Religion News*; and in Britain Peter E. Hodgson of Corpus Christi College at Oxford, OX1 4LF regularly publishes a book review service, *Science and Religion Forum*. The ELCA facilitates a working group on science and technology headed by Prof. Per Anderson, Concordia College, Moorhead, MN 56562.

58 See Imre Lakatos, *The Methodology of Scientific Research Programmes: Philosophical Papers*, vol. 1, ed. by John Warrall and Gregory Currie (Cambridge: Cambridge University Press, 1978).
59 See Barbour, *Religion in an Age of Science*; and Willem B. Drees, *Beyond the Big Bang: Quantum Cosmologies and God* (LaSalle, IL: Open Court, 1990).
60 See his work in Robert John Russell, William R. Stoeger and George V. Coyne (eds), *Physics, Philosophy and Theology* (Vatican City State: Vatican Observatory; and Notre Dame: University of Notre Dame, 1988) and Robert John Russell, Nancey C. Murphy and C.J. Isham (eds), *Quantum Cosmology and the Laws of Nature* (Vatican City State: Vatican Observatory; and Notre Dame: University of Notre Dame, 1993).
61 Philip Hefner, *The Human Factor* (Minneapolis: Fortress, 1993), 260. This book won the 1993 Templeton Book Prize in the field of theology and natural science.
62 Ibid., 261.
63 Ibid., 264; see also 32.