Physics and our view of the world

edited by Jan Hilgevoord

Emeritus Professor of the Foundations of Physics
University of Utrecht

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Willem B. Drees

1 Introduction

It has been said that 'scientific realism is a majority opinion whose advocates are so divided as to appear a minority' (Leplin 1984, p. 1). Something similar happens in the reflections on physics and theology in this volume: even though most contributors share a positive attitude towards religion, they are strongly divided. The discussion is not merely one about answers, for instance whether or not the Universe had a beginning, and whether that supports belief in a divine 'first cause'. The real disagreements concern the questions, the way the problem is posed. Failures to communicate may have their roots in that which is considered obvious, and thus often left implicit, rather than in that which is the explicit topic of the debate. Thus, the aim of this chapter is to achieve a clearer view of the variety of approaches in relating physics to religion.

Before embarking on the main topic, I will briefly argue for the relevance of such reflections.

There is a public relations problem for theology in an age of science. Affiliation with churches is declining. 'Belief in God' is considered by many to be an option which is superfluous, outdated, falsified, meaningless, or a matter of private taste. The role of science in the rise of such attitudes should not be overestimated; many other social factors have also contributed. However, clarifying the relation of religion and science seems important to the future of religion.

There is also a public relations problem for science. Among those for whom religion is important, some feel threatened by science. A

Gallup Poll in November 1991 found that 47 per cent of all Americans supported a strict creationist view ('God created man pretty much in his present form at one time within the last 10 000 years'), whereas 40 per cent endorsed a religious view which had adapted to evolution ('Man has developed over millions of years from less advanced forms of life, but God guided this process, including man's creation'), and only 9 per cent endorsed a naturalist view ('Man has developed over millions of years from less advanced forms of life. God had no part in this process').[1] Defusing feelings of threat, and hence an anti-science attitude, may well be a relevant PR motive for scientists to participate in dialogues on science and religion.

Antagonism is one attitude. Unrealistic expectations with respect to science are another social phenomenon which might be a reason for concern. For instance, a Natural Law Party participated in British elections in April 1992. They claim that superstrings and supergravity confirm old Vedic insights, as presented in the West by the Maharishi Mahesh Yogi. Many more examples of misguided spiritual or material expectations could be listed. Though such expectations may contribute to a friendly environment for the funding of science, they may do harm as well, as they may give rise to counter-reactions when expectations are unfulfilled. Besides, they inhibit the critical role of science through their quest for an encompassing view.

Even though public relations are important, utilitarian grounds should not carry the whole weight of the science-and-religion interaction. In my view, three less pragmatic motives are essential as well. Firstly, there is the need for honesty which presses one to search for consistency, also in matters of religion. Secondly, curiosity may well drive one to relate various fairly distinct human enterprises, since new ideas and insights might come up in an encounter. And, thirdly, concern about the well-being of humans and other living things may be a reason to reflect upon the impact of science and of religion on our self-image and on our culture.

The next section will discuss various views of the problem by making a brief historical tour (2.1) and by arguing that our situation differs from the mediaeval synthesis of religion and science not merely with

respect to the content of science, but also in our view of knowledge and in our appreciation of the world (2.2). These three types of differences may be related to three views of the 'object' of religion: God, mystery or meaning. This leads to a variety of interactions with science (3). Starting from the scientific side, naturalistic and monistic tendencies related to science provide an important context for reflection on religion (4). In the concluding section (5), various niches for religion will be discussed.

2 Various views of the problem

2.1 A brief history of relevance and separation

In the Middle Ages religion and pre-scientific knowledge were integrated. The rise of modern science led to conflicts. This resulted in modern atheism as well as in religion withdrawing from the cognitive domain to apparently inaccessible realms such as ethics or feelings. This story will be sketched and nuanced below. The issue then becomes in what way religion may regain a place in the cognitive realm, or whether it should develop more in line with the insights which resulted in separation.

The medieval synthesis

A synthesis of religious convictions and (pre-) scientific insights seems to characterize the late Middle Ages. Prominent among the scientific insights were those of Aristotle, as mediated through Arabic culture. A major example of a theological system in coherence with the available knowledge is the work of Thomas Aquinas (thirteenth century). However, the synthetic approach has not been restricted to systematic theology. Fiction, like Dante's trilogy about heaven, hell, and purgatory, illustrates the medieval quest for a world-view as well. Ideas taken from the Greek philosophers (Plato, Aristotle), from Holy Scripture, and from the writings of theologians of the first millennium were integrated.

Among the characteristics of the medieval synthesis were its static character, its hierarchical structure and its geocentrism. The order,

built upon Aristotle's doctrine of 'natural place' was not merely understood as something factual; the order was also prescriptive (as some uses of the words 'natural' and 'counter-natural' in our time still reflect). The order of the world was not something accidental, but reflected God's order and providence.

Though some elements in the old synthesis were lost with the rise of modern science, especially its geocentrism (and thus its Aristotelian doctrine of 'natural place'), at first most scientists argued more or less in the same way with respect to religion. The order of the world as science discovered it was the order God had put into it. One could learn about God from the book of Scripture and from the book of Nature. It is a misunderstanding that the beginning of modern science was marked by conflicts between science and religion, or between scientists and the Church. To make clear that the situation has been more complex, let me make a brief digression on the Galileo affair.

The Galileo affair: relevance or neutrality?[2]

The conflict that arose in the seventeenth century around Galileo has often been seen as a conflict between science and the Catholic Church, or even theology in general. However, the conflict also reflected a clash between two views of, and social contexts for, science. There was the scholastic tradition, appealing to previous authorities (Aristotle as 'The Philosopher') and well established in the medieval universities. The new sciences arose in another setting, in combination with trade and crafts in the cities which were gaining in importance. Whereas the then traditional approach equated knowledge and certainty, the new approach led to modern empirical science, ascribing a more provisional and probabilistic status to knowledge. The Galileo conflict may be seen as marked by a specific alliance between the medieval, scholastic tradition in knowledge and certain powerful elements in the Catholic Church rather than as a straightforward conflict between conservative religion and progressive science.

The Galileo affair may also be described as a conflict between two views of religion, especially two views of the relevance of Scripture for science. In Galileo's writings, for instance his Letter to Grand Duchess Christina (1615),[3] two types of argument about the proper way of

dealing with the relation between Scripture and natural science can be found.

(1) *Relevance*. If science has proven certain facts, one has to adapt one's interpretation of Scripture. However, if scientific knowledge is merely 'plausible opinion and probable conjecture' in place of sure and demonstrated knowledge, one would have to give priority to Scripture. 'Where human reasoning cannot reach – and where consequently we can have no science but only opinion and faith – it is necessary in piety to comply absolutely with the strict sense of Scripture.' Thus, the information of Scripture is relevant to our view of the world and vice versa, but Scripture or science needs re-interpretation if a conflict arises. Which one needs re-interpretation depends on the certainty of the claims made by both sides. By the way, science may be open to re-interpretation in two ways. Either the substance itself may be interpreted differently, or the status of scientific statements may be assessed differently. For example, Copernicus' book *De Revolutionibus Orbium Caelestium* (1543) had an anonymous preface (ascribed to Copernicus but now known to have been written by the Lutheran theologian Osiander) which emphasized that these ideas were no more than hypotheses, developed for simplifying calculations, and did not aspire to be true.

(2) *Neutrality*. Galileo also argues for the neutrality of Scripture in matters cosmological, and vice versa. He quotes an ecclesiastical authority who states 'that the intention of the Holy Ghost is to teach us how one goes to heaven, not how heaven goes'. The Bible is only relevant in matters 'which concern salvation and the establishment of our faith'.

Relevance and neutrality

After the rise of modern science various positions co-existed, of which some assumed 'relevance', whereas others took off from 'neutrality'. Some argued for a restricted scope of science and of religion, which might allow co-existence through mutual neutrality. Others argued that science and religion cover more or less the same issues (everything?), which implies relevance of the one for the other, either negatively (conflict) or positively (harmony).

An antagonistic attitude, maintaining an older view of the world despite more recent scientific discoveries, is an example of relevance. Such conflicts continue until our time, 'creationism' being its most well-known contemporary manifestation. Similar to this rejection of science

for religious reasons is the rejection of religion as a consequence of scientific discoveries. Characteristic titles in this context have been A. D. White, *A History of the Warfare of Science with Theology in Christendom* (1896) and J. W. Draper, *History of the Conflict between Religion and Science* (1875). However, as a balanced view of history, this 'warfare' model is far from being the whole story. It too is to be seen in its social context (e.g. Brooke 1991, pp. 33–42).

Others adapted to new discoveries, arguing for the meaningfulness of religion in terms offered by the sciences. This may be exemplified by the English 'arguments from design' tradition. If one were to find a complex item on the shore, and it turned out that that item could be interpreted as indicating the time (a watch), one could argue that the item was designed for that purpose, rather than that the correlation between the position of the Sun and of the hands on the clock was a mere coincidence. Similarly, so the argument goes, one should opt for intentional design of organisms, as their intricacy surpasses the intricacy of watches by far.

Neutrality has expressed itself in emphasizing the differences between religion and science. The idea that religious convictions are neutral with respect to scientific ideas has continued to attract major thinkers over the centuries. One well known example is the philosopher Immanuel Kant, who discussed in his *Kritik der reinen Vernunft* (1781) the status and limitations of theoretical, scientific knowledge, whereas he introduced religion (God, soul, immortality) in the context of his *Kritik der praktischen Vernunft* (1788), his major work on ethics. The theologian Friedrich Schleiermacher (*c.* 1800) placed the feeling of absolute dependence at the core of religious life, thus incorporating the neutrality principle. Feelings or attitudes may also be a meeting ground for science and faith. For instance, the historian of science Olaf Pedersen has argued that, 'when a scientist realises the implications for one's personal existence of the fundamental scientific experience, he has adopted a relationship towards the world which is essentially the same as that which the believer adopts when expressing belief in creation' (Pedersen 1988, p. 138). Science does not disclose God's attributes. Rather, science and faith have to do with similar attitudes towards the world.

A more recent defence of neutrality is provided by the philosopher Ludwig Wittgenstein, who in his later writings emphasized that the meaning of words is to be understood through their use. Thus, the meaning of the term 'goal' may be clear in the context of football, but it is unintelligible in the context of chess. Various practices constitute various language games. Transferring concepts from one language game to another language game, say from religion to theoretical physics or vice versa, is considered a misguided enterprise.

The history of interactions of science and religion does not provide us with a single coherent view of the nature of the problem. Some suggest a lack of adaptation of religion to scientific insights (e.g. Wildiers), whereas others suggest that Christian apologetics went wrong by adapting too much to the terms of the discussion as set by the natural sciences (e.g. Buckley, Dillenberger). Historians, and others, describe the interaction of, or confrontation between, science and religion in terms which fit their own agenda. That is not merely an agenda with respect to the relation between science and religion; their own view of science, religion and human culture is involved. Science-and-religion is not comparable to building a bridge between two territories which are sufficiently well-known. Rather, in reflecting on the connection, one also develops and adapts one's view of the nature of religion and the scope of science.

Besides, in relation to realism in science as discussed in other essays in this volume, it may be noted that those who defend religion are not all on the same side in the realism–empiricism debate. Playing down the claims and scope of science may be one way to create room for religion (Buckley, 1987, 1988; see also Feyerabend, Hesse and van Fraassen in this volume), but scientific and theological realism may also be aligned (Wildiers, 1982, see also Davies in this volume).

2.2 Three 'variables'

New knowledge separates us from the medieval synthesis. Among the changes have been the loss of geocentrism, the longer time scales, and the evolutionary understanding of humanity in relation to the rest of

the living world. However, there are at least two other types of change that should be considered as well.

It was not only the knowledge of Nature that changed, but also our ideas about *the nature of knowledge*. The *subject* acquired a more prominent place. For instance, the philosopher Kant understood as inaccessible the world as it is in itself; the accessible world is the world as *we* describe it in terms of our categories. Although specifying these categories has turned out not to be a straightforward matter, the insight still stands that knowledge is shaped by our categories and not just by the reality it intends to be about. The emphasis on the subject, with his or her categories of thought, is continued in our century with the emphasis on the role of language and context and with the decline of belief in foundations which would provide for certainty. Such issues are central to other essays in this volume: in what sense is our knowledge knowledge *about the world* (realism) and to what extent is it *our construction*, relevant in a specific practical context but not to be granted a more universal meaning independent of that context?

A third change regards *our appreciation of the world*. The mediaeval synthesis took it that the world reflected a divine order. Some continued this affirmative line, even if the order of Nature itself was seen differently. As the poet Pope wrote as the epitaph for Newton's tomb, 'Nature and Nature's laws lay hid in night; God said, Let Newton be, and all was light'. However, others felt that with the loss of the traditional order of the Universe, all sense of order – whether natural or social – was crumbling (see, for instance, Toulmin 1990, pp. 62–69). The changing appreciation of the world is exemplified by the cultural impact of the earthquake that destroyed Lisbon in 1755. The French philosopher Voltaire wrote a *Poème sur le désastre de Lisbonne* (1756). In Voltaire's book *Candide ou l'Optimisme* (1759) the philosopher Pangloss keeps defending the position that this world is the best of all possible worlds. The more Pangloss argues his case, the less convincing it becomes. Whereas the mediaeval synthesis affirmed the world as God's good creation, the present perception allows for meaninglessness and ambivalence among the spectrum of valuations of the world.

Changes in our understanding of religion may be related to all three

developments mentioned above. Some have attempted to adapt contemporary theology to substantial changes in our view of the world. For instance, creation is no longer understood as a once and for all event, but rather as a continuous process. Such forms of adaptation to contemporary insights are to some extent necessary, but they have their problems. We are evolutionarily adapted to think in terms closely connected with common sense experience: 'the Sun rises' rather than 'the Earth turns'. Similarly, we are prone to imagining concepts like 'heaven' as 'above', even though it is hard in a time of world-wide flying to maintain that there is a throne on the clouds. It is not easy to free ourselves from the categories of thinking which were fruitful in dealing with the meso-level of reality that was relevant to survival in the evolutionary development of the human species. Hence, many people experience changes in our way of conceiving of reality as an unnerving loss, even though they may agree on the need for new images and concepts.

Theology has also responded to the emphasis on the human role in knowledge, for example by withdrawing to 'feeling' (Schleiermacher), by taking up Kant's transcendental argumentations about the conditions for the possibility of knowledge or of ethics, by turning to the subjective and personal (e.g. Martin Buber's 'I-thou' in contrast with 'I-it'), or by focussing on religious language and tradition.

Changes in appreciation of the world have affected theology as well. This is most explicit in those theologians who moved from an understanding of God in metaphysical terms, say God as the Ground of Being, to an understanding of God as being on the side of the victims or the poor. The 'Death of God' discussion of the 1960s reflects the stronger emphasis on human autonomy in creating knowledge (the previous point) and in responsibility, as well as a strong sense of the reality of horror, of injustice in the world.[4]

Thus, various authors writing on science-and-religion may easily talk past each other, even though they seem to address the same issues. Underlying presuppositions shape the way the dialogue is presented. We will discuss examples of the contemporary scene in two clusters. Are physics and theology engaged in a common quest for understand-

ing? If so, how is the religious 'object' envisaged: as a God beyond reality, as a mystery at the heart of reality, or as meaningfulness (3)? And if religion is not understood as knowledge about some ultimate reality, how is religion to be seen in the context of the evolution of the human species (4)?

3 Three 'gods' in common cognitive projects

The cognitive relevance of science for religion may be clustered around three ways of thinking about ultimacy: God, mystery, and meaning, correlating more or less with the distinctions made above between changes in our knowledge, in our view of knowledge and in our appreciation of the world (2.2). How might one think about God in relation to the Universe (3.1)? Is mystery a persistent ground for religious wonder (3.2)? Is there ultimate meaning to human existence in the Universe (3.3)?

3.1 God

Empirical science arose, according to A. N. Whitehead (1926), when God was conceived of as endowed with 'the personal energy of Jehovah and with the rationality of a Greek philosopher'. The properties of the world could not have been deduced by thought alone (the Greek strand), but neither could they be taken to be purely whimsical, without regularities, totally dependent upon the mood of some deity. If one adopts this view of the rise of modern science, science and belief in God were allies rather than enemies. One could question this view of the history of science by pointing to other factors, such as the development of technology. However, the themes of *contingency* (3.1.1) and of *rationality* (3.1.2) are still central to discussions relating science and theology. After focussing on these two correlates of divine will and divine reason, we shall discuss 'design' as a more qualitative notion in this context, which may be related to specific intentions of the supreme being, such as its love for humans and its longing for a free response (3.1.3). In conclusion (3.1.4) various ways of understanding 'God' will be considered, such as a Platonist view, with emphasis on rationality, and a deist view, with emphasis on initial contingencies.

3.1.1 *Contingency: room for divine action?*

> . . . , any contemporary discussion regarding theology and science should first focus on the question of what modern science, especially modern physics, can say about the contingency of the Universe as a whole and of every part in it.
>
> (W. Pannenberg 1988, p. 9)

An event, property, or state of affairs is contingent if it is possible but not necessary; if it could have been different. The theologians Pannenberg and Torrance have correlated the contingency of the world with divine freedom. God might have chosen differently. God could have created no world at all, or a world with different ingredients (laws and initial conditions). In extremis one might hold the view that God would not be bound in any way; God could have created something logically contradictory or wicked. Most theologians avoid such consequences by including goodness and rationality in their concepts of God. If one includes relationality in one's concept of God, as process theologians do, God could not lack a creation either. Such a view would have no need for a contingency of the existence of reality.

Various *varieties of contingency* might be considered (e.g. Russell 1988). The contingency of existence refers to the question: why is there anything at all, rather than nothing? Initial contingencies may be presented in various ways. Why did the Universe start with the properties it has? Why did the Universe start at that moment (if seen from eternity), and not, say, infinitely long ago or at some other moment of time? And could the laws of Nature, or the constants involved in them, have been different? Aside from questions about the Universe as a whole, is there some form of 'local' contingency in the processes governed by the laws? The contribution by John Barrow in this volume can be read as an analysis of such contingencies in the context of contemporary physical theories, for example in his discussion of broken symmetries.

It should be clear that, again, not merely the answers are to be debated, but *the ways in which the questions are posed* as well. For example, one may ask whether the Universe had a beginning a finite time ago (the Big Bang theory) or not. One may then consider problems of the kind: 'What was God doing before he created the world?' Rather

than answering this question, the theologian Augustine of Hippo (*c.* 400) replied that the question is wrongly posed, as time is created together with material reality, rather than being an uncreated universal background. A similar move has been made in contemporary cosmology, when the Newtonian concept of time and space as divine attributes was replaced by the general relativistic understanding of space–time as a physical entity. This move is even more explicit in quantum cosmology, where time is not a concept that is universally applicable (e.g. Isham 1991, 1993; Drees 1991, 1993). Thus, the alternatives are no longer an infinitely old Universe or a sudden beginning. Rather, it may be that 'time' loses its status as a universally applicable ontological notion. Similar shifts may occur for other types of contingency: rather than answering the question, one might reflect upon the question and reformulate it in a more appropriate way.

Contingency and necessity seem to me to be relative terms; something is contingent or necessary in the context of a theory. Science assumes a principle of sufficient reason, the heuristic principle that one should always seek reasons. However, this is a methodological principle rather than a metaphysical principle, which would claim that there always *must* be reasons. Absolute necessity is beyond science. And absolute contingency is also beyond science. Something which is contingent in the context of current theories may be shown to be unavoidable given certain circumstances.

There seems to be *an emotional resistance against contingency*, as it seems to make the course of life uncertain, a consequence of random events rather than of intentional decisions. 'Conspiracy theories' signal the emotional resistance against interpreting processes as contingent. If bad luck causes the loss of a dear one, some may attempt, in my opinion misguidedly, to comfort those that grieve by suggesting that the loss might be according to a higher plan. Thus, one might be religiously motivated in opting for a hidden variables view in quantum theory, according to which all, apparently random, correlations between events are traced back to a higher coherence.

The discussion about contingency is similar, though more ontological in language, to the discussion about complete theories and the reach

of science (which is more epistemological in language, though not exclusively so, e.g. Barrow 1988, 1991 and in this volume). It seems closely connected with ideas about divine creation and interference.

The discussion may focus on global issues, such as 'the beginning' of the whole of reality. However, it may also be directed towards local contingency, concerning a part of reality. One might consider quantum theories and chaos theories as referring to local contingencies in reality. However, these theories can be interpreted deterministically as well. For example, Many Worlds Interpretations of quantum theories, which take it that all possibilities have equal ontological status, imply that there is no contingency of this kind, though the theory itself may still be considered contingent.

The interest in 'local' contingencies may be triggered by the quest to find an acceptable way of thinking about divine action in the world. Another interest might be to find a place for human free will. However, 'free will' should not be confused with randomness and unpredictability; it is more like 'self-determination'. Thus, philosophers have also argued that free will is compatible with full determinism (Dennett 1984). Some determinism is necessary for a meaningful understanding of free will, for otherwise it would be impossible to make plans and carry them out.

The reverse side of the emphasis on contingency may be exemplified through a reference to the polemical book by the British physical chemist Peter W. Atkins, *The Creation*. As he sees it, science has traced complex entities back to simpler entities, and these to the vacuum, which may have arisen by chance. He develops the view that

> the only way of explaining creation is to show that the creator had absolutely no job at all to do, and so might as well not have existed. We can track down the infinitely lazy creator, the creator totally free of any labour of creation, by resolving apparent complexities into simplicities, and I hope to find a way of expressing, at the end of the journey, how a non-existent creator can be allowed to evaporate into nothing and to disappear from the scene.
>
> (Atkins 1981, p. 17)

Removing contingencies by offering encompassing explanations would do away with tasks for a deity. One might nonetheless introduce an

inactive deity, or even a deity which created it all by hand, but that would be superfluous, against the spirit of science (Occam's razor).

3.1.2 *Order and intelligibility: divine rationality?*

Whereas emphasis on the role of experiments in science seems to align with the interest in contingency, one could suggest that the role of mathematics in science aligns more with stress on rationality. The mathematical nature of the order of the Universe may suggest religious themes, especially to theoretical physicists and cosmologists. Sir James Jeans referred to God as a pure mathematician, and Paul Davies titled his recent book *The Mind of God: The Scientific Basis for a Rational Universe* (1992). And the Polish cosmologist and priest Michal Heller wrote:

> Mathematical structures that reflect the structure of the world are indeed able to provide a kind of ultimate understanding. In a theological perspective the ultimate rationality is that of God. The fact that it is a mathematical type of rationality is not a new factor in theology. The metaphor of 'God thinking the Universe' is well rooted in the history of theology.
>
> (Heller 1990, p. 207)

One might consider the intelligibility of the Universe, our capacity to grasp the regularities of the Universe, to be the amazing aspect which invites further reflection of a religious kind. Thus, the Canadian philosopher Hugo Meynell argued that the emphasis should be 'on the explanation of the intelligibility of the world, rather than on accounting for the gaps in that intelligibility' (Meynell 1987, p. 253). It is a kind of second order argument. Different cosmological programs suggest very different ontologies, but they have in common that they provide an intelligible Universe. What is it about the Universe and about us that makes it possible to think in an orderly way about it; in other words, makes it possible to frame adequate mathematical theories? Meynell defends the view that 'there is something analogous to human intelligence in the constitution of the world' (1982, p. 68). Paul Davies addresses similar questions in his recent book (Davies 1992) and in his contribution to this volume. He holds the view that the capacity to do the relevant mathematics is not evolutionarily explicable. I will use the

opportunity to suggest some of the problems that the position of Davies might have to face.

(1) Is it true that the world is intelligible? Who understands quantum theory? Many are able to work with the formalism, but 'understanding' is an ambiguous term, as the following anecdote from an Oxford exam of about a century ago, quoted by Barrow (1988, p. 193), illustrates.

> Examiner: What is Electricity?
> Candidate: Oh, Sir, I'm sure I have learn't what it is – I'm sure I *did* know – but I've forgotten.
> Examiner: How very unfortunate. Only two persons have ever known what electricity is, the Author of Nature and yourself. Now one of them has forgotten.

Almost everybody knows that the light switch affects the light. Many believe they understand it. But those that continue questioning may well raise difficulties. Electricity is manipulable and well describable by Maxwell's laws. However, is manipulation and calculation the whole of understanding?

(2) The fact that mathematics is so effective in theoretical physics may be like the amazing fluency of natives in their own language. Physicists have been trained in using mathematics, so why should one be surprised if they use it and find it effective for the problems they deal with? It might well be a property of their approach or of the problems they select. However, such a rebuttal seems too easy. Mathematical science has an effectivity which is also recognized by those not trained in mathematics.

(3) An evolutionary explanation assumes that the capacity for knowing may have been advantageous to those who had it. It seems obviously advantageous to be able to anticipate the trajectory of a moving object, say a falling apple, a stone or a spear. However, what could have been the advantage for early hominids of being able to work out explicitly a mathematical theory of these phenomena? We seem to have been served more than we ordered. The ability to do abstract mathematics seems evolutionarily inexplicable – a product of design rather than of evolution?

The case for an evolutionary explanation might be defended by considering the similar problem for reading and writing. Whereas the ability to use speech seems to have co-evolved with certain structures in the brain, this cannot have been the case for reading and writing, which are fairly recent cultural innovations. In this case it seems likely

that certain already existing structures in the brain were used for the new purposes of reading and writing, perhaps structures that previously served in interpreting tracks of animals (and were therefore evolutionarily selected). An inexplicable preadaptation of the brain to reading is an unnecessary assumption. Rather, the evolutionarily explicable plasticity of the brain allowed for these new forms of behaviour. Similarly, we may be able to use the ten fingers to play the piano, although they evolved due to other evolutionary pressures. And similarly, one might argue, there could be a potential for abstract mathematical reasoning, though the corresponding brain structures were developed for other purposes due to other evolutionary pressures.

(4) The apparent intelligibility and lawfulness of the Universe may also be a consequence of selective observation. One could imagine a chaotic Universe, with some temporal eddies of regularity and intelligibility. Complex organisms, such as human beings, might exist only in such eddies, and hence observe regularity and infer intelligibility. An analogy may be taken from economics. One might think that intelligible economic development correlates with a strong central planning agency. However, a free market economy may, in principle, also lead to an overall intelligible development even though there is no overall planning. One could interpret this by formulating 'freedom' as the overall principle, but one could also say that there is no principle. This is the line of thought behind J. A. Wheeler's quest for 'law without law'. The trend in theoretical physics may be towards complete intelligibility, a unified Theory of Everything. 'But it may be that our undoing of the catalogue of Nature's laws will take us down a different road, which will lead us to the recognition that there is no such ultimate Theory of Everything: no law at all' (Barrow 1988, p. 297).

3.1.3 *Design and the anthropic coincidences*

Even if contingency, intelligibility or unity would allow an interpretation in relation to God as creator, they seem to lack specific intention. The specific order of the Universe might, however, be interpreted theistically as evidence that God is not interested in creating any odd universe, but a universe in which beings of a certain kind can exist.

The most recent variant of such thinking has been debated in relation to the anthropic principles (e.g. Barrow and Tipler 1986, Davies 1982, Drees 1990, pp. 78–89; see also Barrow and 't Hooft in this volume). The Universe has certain properties, for example three spatial dimensions, a certain size and age, a specific strength of the

gravitational force compared with the electromagnetic force. One might consider other universes with other properties. It turns out that most of such imagined universes would not allow for the evolution of complex organisms based on carbon chemistry. Thus, we seem to be extremely lucky that the Universe actually has the properties it has.

The discussion needs some distinctions. First, one should distinguish between the *anthropic coincidences*, as I prefer to name correlations between properties of the Universe and our existence, and the *anthropic principles*, which may be seen as various attempts to interpret the coincidences. Among these are the Weak Anthropic Principle, which points out that what we see is biased in favour of those parts of the Universe where we can exist, thus emphasizing that the coincidences may have to do with selective observation. There are also Strong Anthropic Principles, which suggest that these properties are in some sense necessary for any possible universe, whether observable or not.

Within this latter category one might consider as a specific case a Theistic Anthropic Principle: these properties are a consequence of design. An attractive feature of the design argument is that it suggests something about God's intentions, of which humans are a part. Perhaps God created our kind of world because God wanted a world in which living, conscious and sentient beings could live and relate to God in a freely loving way. Freedom of response might have been such a highly valued good for the creator, that the creator was willing to sacrifice full control of the processes. Along such lines some have suggested that belief in a powerful and loving God might be compatible with the evil and suffering present in the world (a free will and free process defence).

I have doubts regarding the anthropic arguments and their religious use, which I will present below.

The *Weak Anthropic Principle* (WAP) states that what we see must be compatible with our existence. We see a Universe with planets, as our existence depends on planets. We see a Universe which existed for billions of years, because it took billions of years to develop beings which are capable of thinking about the age of the Universe. The WAP has the nature of a selection rule: our observations are biased in favour

of situations where we can exist. It is as if we attempt to find out how often railway crossings are closed. If we observe them only from trains, we will find that crossings are always closed. In cosmology, we can observe the Universe only from a spatially and temporally very restricted set of points of view. Thus seen, the WAP has no metaphysical significance but is a reminder of the biased nature of our observations.

I think that the WAP is correct but devoid of relevance. If we know that life depends on liquid water and we observe the existence of life, we may conclude that our environment must contain water, and thus must have a temperature within a specific range. This is the common use of evidence: we observe life and conclude that something else which goes together with life is also the case. This does not explain either our existence or the existence of water. The explanation of an event or of certain conditions is in general something different from the explanation one offers when asked 'How do you know?' From the existence of this chapter you may infer the existence of its author, but the paper does not explain my existence. Retrograde reasoning justifies beliefs, but it does not explain why the situation was the way it was.

The WAP might be combined with the idea that *all possible worlds are actual*. The latter has been defended, for example in analogy with a Many Worlds Interpretation of quantum theory or in the context of specific cosmological theories which allow for many different regions (larger than our observable universe) with different properties. The existence of our Universe with its anthropic coincidences is then explained on the basis of the assumed actuality of all possibilities. The explanation is not so much due to the principle of selective observation (WAP), but to the metaphysical view that all possibilities are actual (plenitude), which 'explains' the existence of quite a lot.

The *Strong Anthropic Principle* (SAP) has been stated thus: 'The Universe must have those properties which allow life to develop within it at some stage in its history' (Barrow and Tipler 1986, p. 21). This is not a statement about what we actually observe, but about the class of possible universes. It leads to an explanation of properties of the Universe in terms of purpose: a property that is necessary for life is necessary for the Universe. Such teleological explanations have a long his-

tory, but they are not widely accepted in contemporary science. SAP arguments have some disadvantages. (1) Properties of other possible universes are unobservable and untestable. Thus, strong anthropic reasoning cannot rely on testable consequences about the class of possible universes, but must base its appeal on the coherence of the view which it supports. (2) Is it helpful to explain the properties of the Universe by reference to life or consciousness, which in all its richness (and possible other forms) is not fully understood? (3) SAP explanations are vulnerable to future developments. Successive theories have, generally speaking, fewer and fewer parameters. If that trend continued, the set of possible universes (without invoking SAP reasoning) might be very small, perhaps even containing only one possible universe, ours.

If applied at a smaller scale, as in 'planets must have the properties which allow for the development of life in some stage of their history', a Strong Anthropic Principle is surely false. However, the example shows the teleological nature of SAP: everything must have a purpose. Hence, the Moon must be populated, as the ancient philosopher Plutarch argued.

A Theistic Anthropic Principle? John Polkinghorne, a professor of theoretical physics who became an Anglican priest, calls the ideas about other worlds 'metaphysical speculation'. 'A possible explanation of equal intellectual respectability – and to my mind greater economy and elegance – would be that this one world is the way it is because it is the creation of the will of a Creator who purposes that it should be so' (Polkinghorne 1986, p. 80).

Such an apologetic strategy does not work. (1) The argument assumes that the anthropic coincidences are here to stay. However, some (or even all) of these features, which apparently point to design, might find more traditional scientific explanations in future theories. That has happened for the traditional design arguments based on intracosmic adaptedness. The inflationary scenario in cosmology has already led to some erosion of anthropic coincidences. (2) The idea that the assumption of a single creator is more economical than the argument of a plurality of worlds (with WAP selection) is a misapplication of the 'economy' rule (Occam's razor). It is simpler to accept a

theory, say about the formation of planetary systems, in its predictions beyond the observable domain, than to draw a line between what is currently observable and the rest. The issue of simplicity and economy is not so much one about the number of entities predicted by a theory but one about the structure of the theory. Some cosmological theories are more simple if one allows for the existence of many worlds than if these were to be excluded. (3) The argument for design assumes that certain features of the Universe are improbable if not for design. However, the probability or improbability depends on the features considered and on the class of alternative universes considered. The basis of the argument is not as objective as it seems, as has been pointed out by Ovenden (1987, pp. 105f.).

3.1.4 *What kind of God?*

> 'The most miraculous thing is happening. The physicists are getting down to the nitty-gritty, they've really just about pared things down to the ultimate details, and the last thing they ever expected to happen is happening. God is showing through.'
> 'Mr Kohler, What kind of God is showing through, exactly?'
>
> (Dialogue between a computer freak and a professor at a divinity school, in *Roger's Version* by John Updike (New York 1989, p. 9)

As in the quoted dialogue, it is relevant to ask 'what kind of God' is appearing in the context of such cognitive dialogues between science and religion.

'God' may be thought of as the cosmic watchmaker, the engineer who constructed the initial state and lit the fuse. Carl Sagan wrote in his preface to Stephen Hawking's *A Brief History of Time* that the consequence of Hawking's theory is that there is no absolute beginning of reality, and therefore no need for a creator (Sagan 1988, p. x). A similar *deist* notion of God seems the aim of arguments that purport to show that there was an absolute beginning, inexplicable within the Universe, and hence a cause beyond the Universe.

When Hawking concluded his book by linking knowledge of the ultimate theory to knowledge of 'the mind of God', he used a more *Platonist* image of God. Other examples of this kind of thinking among theoretical physicists are Roger Penrose's defence, in his *The*

Emperor's New Mind, of the reality of a timeless realm of mathematical truths, and Paul Davies' discussion, in his *The Mind of God*, of the relation between mathematics and reality (see also the essays by 't Hooft and Davies in this volume).

A *theist* view has God both as the highest (transcendent, timeless) being, a Platonist element, and as the original creator, a deist element. Besides, God is understood to be active in time, either in human history or in the whole course of evolution (*creatio continua*). This position is not an easy one to maintain, since these aspects of God are hard to combine with each other.

An alternative may be a *pantheist* view, which assumes an ontological identity of God and world, rather than the more dualist conceptions mentioned before. We will return to such views in the next section, on mystery.

3.2 Mystery: a common awareness of not-knowing?

Robert Jastrow concluded his *God and the Astronomers* with the following image.

> For the scientist who has lived by his faith in the power of reason, the story ends like a bad dream. He has scaled the mountains of ignorance; he is about to conquer the highest peak; as he pulls himself over the final rock, he is greeted by a band of theologians who have been sitting there for centuries.
>
> (Jastrow 1980, p. 125)

The essence of modern cosmology is, according to Jastrow, that the Universe 'began at a certain moment of time, and under circumstances that seem to make it impossible – not just now, but ever – to find out what force or forces brought the world into being at that moment' (1980, p. 12). Theology always lived with the awareness of its inability to express what God is. This section will not deal with the cosmological issue; Jastrow's specific example is in need of modification due to the development of quantum cosmology (Isham 1991, 1993). The issue here is the emphasis on the limits of human knowledge. Is there a common meeting ground for religion and science in not-knowing?

One of the Ten Commandments in the Jewish and Christian heritage is the prohibition against worshipping idols, a practice which is con-

sidered religiously and socially destructive. The Greek heritage developed a more metaphysical and epistemological critique of anthropomorphic concepts of God. As the origin of knowledge and existence God is beyond knowledge. Later systematic thought in Christianity distinguished between two ways of thinking about God's attributes. The first way is one of extrapolation and affirmation. We know to a certain extent what 'power', 'presence', and 'wisdom' mean. God is then thought of as omnipotent, omnipresent and omniscient. The other approach is labelled the *via negativa*: we deny features of reality in reflecting upon God. Stating that God is atemporal is not a positive statement about God's nature, but a denial of temporality. 'God is infinite' is not a cognitive statement, as if one claimed to know what 'infinite' meant, but a denial of creaturely finitude. We should respect the 'is not' character of metaphors, especially in religion, as they save us from absolutizing images and falling into idolatry (McFague 1982). That would result in a loss of sensitivity for the symbolic nature of religious language. Thus, recognition of God as the unknowable, as a mystery at the heart of religion, seems well rooted in religious thought.

Are there any reasons within science to assume that there is a mystery about which we cannot speak scientifically? In his *Cosmic Understanding* (1986) Milton K. Munitz gave a philosophical analysis of scientific cosmology. The Universe as it is known, as an intelligible unit, is a product which results from the application of a conceptual scheme. This should not be misunderstood, as if reality owes its existence to concepts. It is an epistemological point: all theories about the Universe are constructs which use human concepts. Conceptual boundedness is inescapable if one wants to achieve intelligibility. One aims at transcending the conceptual limitations of a theory by entering another conceptual scheme, which has its own boundaries. A similar point has been made by Harrison in his *Masks of the Universe* (1985). Each understanding of the Universe is a mask which is held in front of the real, but in itself unknowable, Universe.

One could stop here. Is there 'a dimension of reality "beyond" any account of the known Universe (or any of its contents), of which we can have a mode of awareness that is not hemmed in by the constraints

and ever-present horizons of cosmological knowledge?' (Munitz 1986, p. 229). The epistemological endlessness of the cosmological search might be due to such an ontological 'ultimate boundlessness or indeterminability at the very heart of reality' (Munitz 1986 p. 229). This reality would not be conceptually bounded the way the Universe is, nor would it be bound by anything beyond itself. 'Boundless Existence' is not the name of an object or entity.

> We shall be driven, consequently, and at the end, to silence, although the 'talk' on the way, if at all helpful, will have its value in making the silence a more pregnant one, and indeed the occasion for having an overridingly important type of human experience.
>
> (Munitz 1986, p. 231)

Munitz attempts to point to something which epistemologically transcends all our knowledge – something which is, however, at the heart of reality, hence ontologically immanent.

In the context of quantum physics, Bernard d'Espagnat has argued that 'we have to reckon with two realities. More precisely, present-day physics calls for a clear-cut distinction between two notions both designated in the past by the word 'reality', independent reality which is distant, 'veiled', and empirical reality, the totality of phenomena (d'Espagnat 1989, p. 7). It is this latter reality that we understand better with each day that passes. Positivist thinkers, both from philosophy and in the Copenhagen tradition of quantum physics, have attempted to rule out independent reality as meaningless. Materialists and realists tend to subsume the notion of empirical reality under that of independent reality. However, 'in our time science itself has provided us with pressing reasons for accepting the (philosophical) duality of Being and of phenomena' (d'Espagnat 1989, p. 7). These reasons are taken from quantum physics, which is not merely about the nature of reality, but about the possibilities of knowing about reality.

Does science suggest the existence of an unknowable or veiled reality? This question is strongly linked with discussions regarding scientific realism with which various chapters in this volume deal. Besides, one

should not merely consider what we do not know (which might be knowable or unknowable), but also what we know negatively. Ideas previously held to be true, or probable, have been shown to be wrong, or at least probably wrong. Science may not be able to provide a grand view of reality, including the mysterious, but scientific research may serve well to criticize ideas about that reality. This could be liberating, as it creates room for new ideas.

If the 'veiled reality' (d'Espagnat) or 'boundless existence' (Munitz) is taken seriously, one still may wonder what its significance for religion can be. Is it merely an expression of our cognitive limitations, and the recognition of unknowable or partly knowable aspects of reality? Is that sufficient to inspire religious awe? Or does religious mystery presuppose certain qualities about that mysterious reality, which might justify associations with love, trust or beauty? It is not clear to me how such a transition of categories is to be made in the context of these approaches.

Besides, there may well be a strong hesitancy in theological circles to make too much out of these apparent mysterious aspects. The methodological catch word is the 'God-of-the-gaps'. It has happened that gaps in a scientific account, e.g. an account of the evolution of the human out of earlier mammals, or of complex physical phenomena, were seen as possible loci of special divine intervention. Such an approach disregards the coherence of the scientific account, and may result in a religious position which is always on the retreat as science successively fills such gaps. Are there gaps which do not erode? Are these mysteries of Munitz and d'Espagnat persistent? Or will there be a future theory beyond quantum physics which lends itself much better to an interpretation of reality in a single scheme of objective reality, without the distinction between veiled and empirical reality? One might connect this with the earlier discussion about contingency: is there any contingency that will be inaccessible to science? Are the laws of nature possible candidates, or might they be necessary? And what about the existence of something rather than nothing?

3.3 Meaning: human existence in the Universe

Neither 'God' nor 'mystery' is the concept central to contemporary religious thought. 'Meaning' seems to have become a replacement

which is more acceptable to many in contemporary secular Western culture because it is less suggestive of anything supernatural.

Order out of Chaos (1984) by Ilya Prigogine and Isabelle Stengers has as its title in the original French edition *La Nouvelle Alliance: Métamorphose de la Science* (1979). The claim is that there is a new alliance between humans and Nature, due to changes in science. The classical (Newtonian) physical sciences used to think of reality in a way in which human existence was itself a marginal side product of the evolutionary process of mutation and selection. But developments in science are believed to have paved the way for a new view of the place of humanity in natural reality. Unlike the covenant of Moses at Mount Sinai, this one is an alliance between humanity and physical reality. Humans are no longer strangers in a mechanistic world. The central tenet of Prigogine and Stengers is that 'science is rediscovering time' (1984, p. xxix). Their case is based upon the development of thermodynamics for systems which are far from equilibrium, which, under the right circumstances, develop into new ordered states.

When Nobel Prize winner Prigogine and his co-author Stengers claimed a 'new covenant', they were responding to Nobel Prize winner Jacques Monod whose influential book *Chance and Necessity* ended with the following sobering (or liberating?) thought:

> The ancient covenant is in pieces; man at last knows that he is alone in the unfeeling immensity of the universe, out of which he emerged only by chance. Neither his destiny nor his duty have been written down. The kingdom above or the darkness below: it is for him to choose.

The kingdom above is the kingdom of knowledge, 'within man, where progressively freed both from material constraints and from the misleading servitudes of animism, man could at least live authentically' (Monod 1971, p. 167). The 'darkness below' is the variety of animisms, including utopian ideologies such as historical materialism. The ethics of knowledge is based on an ethical choice, an axiom which humans impose on themselves. It 'thereby differs from animist ethics, which all claim to be based on the "knowledge" of immanent, religious or "natural" laws which are supposed to impose themselves on man' (Monod

1971, p. 164). Animisms fail to make the proper distinction between judgements of value and those of knowledge.

> It is perfectly true that science attacks values. Not directly, since science is no judge of them and *must* ignore them; but it subverts every one of the mythical or philosophical ontogenies upon which the animist tradition, from the Australian aborigines to the dialectical materialists, has based morality: values, duties, prohibitions.
>
> If he accepts this message in its full significance, man must at last wake out of his millenary dream and discover his total solitude, his fundamental isolation. He must realize that, like a gypsy, he lives on the boundary of an alien world; a world which is deaf to his music, and as indifferent to his hopes as it is to his suffering or his crimes.
>
> (Monod 1971, p. 160)

Whereas Prigogine and Stengers may be seen to argue for close ties between humanity and the cosmic processes, Monod describes humanity as a cosmic oddity, arisen by accident. Meaning is not found in that process, which is described by science, but rather in a more existentialist mood in the human choice for objectivity. Objectivity as the ethical axiom cannot itself be based upon some scientific objective basis. It is this ethical axiom which bars science from becoming a basis for further values.

The merits of various proposals about science and meaning, also in the context of other sciences, deserve, of course, more detailed discussion than can be given here. I want to conclude by suggesting a position which is intermediate between meaninglessness and meaningfulness. The astronomer Hubert Reeves refers to the myth of Prometheus when he discusses the development of nuclear weapons. An unprecedented capability for destruction is based on an impressive amount of knowledge. We are placed in a border zone, between good and evil. The development of complexity, life, consciousness and intelligence in the course of cosmic evolution is ambivalent. Meaning is something we may create, rather than detect.

4 Naturalist challenges for religion

So far we have concentrated on different views of the 'object of religion', God, mystery and meaning, correlating these with changes

in knowledge, views of knowledge, and in appreciation of the Universe. Now we will take our starting point from the scientific side. It will be argued that science poses serious challenges to religion; not just to religion which takes science to be relevant, but also to religion which seeks mutual neutrality through separation (see above, 2.1). We will say a few words about the nature of science, before turning to scientific approaches to religion.

4.1 The nature of science

> Mountain peaks do not float unsupported; they do not even just rest upon the earth. They *are* the earth in one of its manifest operations.
>
> (John Dewey, *Art as Experience*, 1934, p. 3)

The motto of this section intends to capture an outlook which is shared by most people involved in science. Mountain peaks do not float unsupported, nor do they rest upon the Earth. Rather, they are manifestations of the Earth. Similarly, expected and unexpected phenomena are assumed to be part of the same physical reality. When superconductivity at higher temperatures was discovered, no one doubted that that phenomenon would be, if confirmed, a manifestation of the possibilities of matter, even if it was not yet understood how it fitted into existing theories. Such an assumption, taking all phenomena to be manifestations of a single reality guided by the same basic laws, correlates with the methodological rule that one should search for naturalist explanations similar to those that were adequate for simpler phenomena. Thus, explanation of biological phenomena in chemical terms will be attempted, even though some biological concepts go beyond the vocabulary of chemistry. Ontological monism without reductionism of all sciences to physics is one of the contemporary positions presented by Dieks in his essay in this volume. Even if one agrees that complete reduction to physics is impossible, the attempt may be heuristically useful. Since the basic rules of physics and chemistry do without 'purpose' or 'goal directedness', one is led to the idea that biological evolution should be explained without reference to an overall purpose, even though individual organisms do have purposes, if described at a level which allows for such a concept.

In this context, two methodological rules are often invoked, though it is difficult to express them both in a precise form and with general

applicability. The first rule, 'Occam's razor', named after the fourteenth-century theologian William of Occam, demands that one should not introduce additional entities or principles without good reason. What counts as good reason needs, of course, further discussion in any specific situation. Using this rule, adding a religious explanation when one could do without one, is against the spirit of science.

The other methodological rule, requiring the avoidance of *ad hoc* assumptions, works against religious superstructures as well. This can be illustrated by the way P. H. Gosse harmonized Darwinian evolution with his belief in a fairly recent creation of all species. In his book *Omphalos* (navel) (1857) he argued that God had created Adam with a navel, suggesting a mother where there had been none. The trees in the Garden of Eden had been created with a complete set of annual rings, suggesting growing seasons though there had been none. The fossils suggest an evolutionary history, but one can not refute the possibility that God created them in the appropriate strata. This view is logically consistent, but contrived, *ad hoc*. All extragalactic and most intragalactic astronomy as well as palaeontology would become a study of God's magic rather than a study of stars, galaxies, and of species that once lived on Earth. It may be hard to specify precisely when a move is to be considered *ad hoc*, but that does not take away the intuition that certain moves are to be avoided.

We will now turn to the understanding of the phenomenon 'religion' under the monist assumption. However, it should be noted that not all working scientists nor all philosophers agree on the assumed ontological monism (see, for instance, Feyerabend, Chapter 6, in this volume).

4.2 Naturalist views of religion

Reflections on God, meaning and mystery assume that religion embodies significant cognitive insights. Some serious thinkers, both scientists and theologians, see religion not as a metaphysical supplement to scientific explanations, but as dealing with other aspects of human existence. As will be argued here, such a view of religion does not imply that there is no need for a dialogue with the natural sciences. Religion may be far removed from physics, but an existentialist, ethical, or anthropological

view of religion gets one into a discussion with naturalist approaches in biology and, beyond biology, in the human sciences.

Humans, with their epistemological capacities and their habit of making moral judgements, evolved from other hominids in correlation with the evolution of culture, e.g. the use of language and the ability to perceive and communicate various states of affairs. According to Alexander (1987), mechanisms of indirect reciprocity and social status within a group and the need for coherence, and mutual support in the competition with other groups of hominids, may have been important evolutionary pressures in favour of morality. The advantage of deceiving others, and the advantage of recognizing attempts at deception, may have been important factors in the evolution of the unconscious and of consciousness.

One might adopt a similar diachronic and functional approach to the origin of religion. Maybe religions arose in the evolutionary history of the human species as an essential ingredient for the emergence of distinctive characteristics of the human species, for instance by making possible large communities, inexplicable by relations of kinship alone. Burhoe (1981) argues for a co-evolution of human genetic and cultural information, with religion (ritual, narratives and more systematic systems of thought) imprinting cultural values into the human brain. As he sees it, religions have been essential to the evolution of the brain. Ritschl (1984, p. 34) discusses religion in the context of cultural pressures in a far more recent phase, as a way of dealing with stress when hunter-gatherers became sedentary. Whereas Burhoe, a Unitarian of Calvinist background, interprets evolutionary history in the context of an understanding of God as sovereign, powerful and selective, the Lutheran Theissen (1984) puts emphasis on tolerance for variation and grace (cf. Drees 1991a, pp. 92–100). Theissen seeks through a functional approach an ontological perspective on God or 'ultimate reality', understanding it as the realm to which successive adaptations adapt. Even if religion (ritual, myth and systematic reflection) arose as a consequence of certain evolutionary pressures, that does not exclude the possibility that there is a genuine transcendent referent of religious worship. However, in adding such a transcendent referent one is in danger of violating Occam's razor.

Besides the evolutionary perspective, one might also consider genetics, neurophysiology and other biochemical approaches to human nature. Is it possible to discuss human religion and morality independently of studies of such underlying structures? Reflections on genes and identity may well bear upon religiously relevant notions such as soul and body, spirit and flesh, self, immortality and resurrection, death, mystery (as the wisdom encoded in our genetic heritage is only secondarily accessible in language; Eaves 1991, p. 499), sin and grace (Eaves and Gross 1990).

Whether there is a role for physics apart from biology, is not easy to judge. The theologian Pannenberg (1985; see for a criticism Eaves 1989) prefers to stick to the work on open systems of Prigogine and others when discussing the phenomenon of life, whereas he turns to anthropologies of a philosophical nature when discussing the distinctively human, thus avoiding a confrontation with sociobiology and genetics. John Polkinghorne (1991) sees chaos theories as a first approximation to a physical theory which allows for human freedom and for divine action in the world. Appealing to contemporary physics in arguments regarding determinism, free will and self-determination is not easy (e.g. Earman 1986). Some problems arise due to the implicit leap from physical discourse to the discourse of the humanities. The intermediate levels of biological reality enrich the conceptuality, both with respect to persons and environments, in such a way that the discussion changes. On the one hand, using physics to avoid confrontation with geneticists and sociobiologists seems an unwarranted eclectic approach. On the other hand, is it possible to defend the concept of a free will without allowing for various possible outcomes, and hence without having an ontology which allows for various possibilities in connection with actuality? Or is a fully determinist view, without local contingencies, acceptable even if one wants to maintain notions like free will and responsibility, as Dennett (1984) defends?

As this section illustrates, even if one separates religion and science by emphasizing that religion has to do with personal aspects whereas science deals with non-personal aspects, one might need to reflect on science, especially where it deals with our view of human nature, including its social and emotional aspects.

5 Niches for religion

Various options for religion in relation to the natural sciences are available. One option might be to dismiss the scientific results. Such an approach, as has arisen in relation to evolutionary biology, seems to neglect the coherence of the sciences (see, for example, Kitcher 1982). Thus, the following will be restricted to approaches which intend to take science seriously. One option, not in all respects unlike the fundamentalist antagonism, is the dismissal of religion as being in direct conflict with science, or, at best, as having become totally superfluous. This line has been presented in an elegant, polemical way by P. W. Atkins (1981). However, before dismissing religion altogether, we may consider whether there are any other options available.

Playing down the naturalist account seems to be one possible strategy. Perhaps the case for science was overstated. If science consists of many theories which are successful in some restricted domain without justified pretensions regarding a greater unity, the assumed ontological monism might be discarded fairly easily. This option seems to characterize the essays of Hesse and Feyerabend in this volume.

If such a line is followed, science is still relevant to religion in two ways. (1) In those domains where science has successful theories, one should take good care to avoid contradicting them. Science may perhaps be unable to provide an encompassing theory, but there are many discoveries about the way the world is, or even more important, about the way the world is not. Clinging to refuted ideas, like a flat Earth, would inhibit the plausibility of the religious convictions espoused. (2) Science and religion are relevant to each other by contributing to a clearer view of the proper scope and limits of each enterprise. Thus, conflicts will be avoided by distinguishing more carefully between the businesses of science and of religion (e.g. Brümmer 1991, pp. 10ff.).

One might also opt for a niche *within the naturalist account*. It would be too easy, in my opinion, to claim divine intervention in order to explain phenomena, such as the origin of life, the extinction of the dinosaurs or the realm of quantum uncertainty. Such a God-of-the-gaps

is in danger of having to retreat when science advances. Specific human feelings may seem to be outside the scope of the naturalist approach. However, confidence in the possibilities of regular explanations of such phenomena is well expressed by 't Hooft. The size and age of the Universe are to be expressed in such enormous numbers (counted in Planck times and Planck lengths) that this allows for 'feeling', 'free will', 'life' and something like awe and reverence for the immensity of the Universe ('t Hooft 1992, p. 231).

One might challenge the adequacy of naturalist approaches to religion. However, one might also accept those explanations, but add that such explanations do not bear on the possibility of a genuine religious response, as one could always exclaim 'Was that God's way of guiding me into faith?'[5] Such an overlay on top of the naturalist explanation is superfluous, and thus in danger of being shaved away by Occam's razor, even though there is no inconsistency. Once my children learn that gifts come from parents and grandparents, they might add that that is Santa Claus' way of providing for the gifts. However, they will soon start to look differently upon the whole happening, though it might remain a nice family event. The experience changes as a consequence of the newly acquired understanding.

There may be a relevant distinction between the description 'from outside', and one from within a specific perspective. The experience from within may be significant, even though another description 'from outside' is available. Without much hesitation we accept that the Earth rotates, while we experience the Sun setting. The experience is still there, but now tied to our specific perspective. Even if the 'thou' metaphor which we use in speaking to God would be 'metaphoric, something is lost when we attempt to translate the religious reality to the language of 'it', much as the joy of sex is not always enhanced by understanding the neurobiology of orgasm' (Eaves 1991, p. 502). Though some pioneering work has been done (e.g. Burhoe 1981, Theissen 1984), we still need a clearer view of the importance of religious life if one accepts functional views of religion and morality.

One might also attempt to find a niche *apart from the naturalist account*. The proper role of science in relation to religion could be in

ethical considerations. Medical ethics is a growth business; the physicists, chemists and biologists have their issues. Among these are nuclear weapons, environmental pollution and genetic engineering, all of which have attracted public attention. Besides, one might reflect on the economical ethics involved: what moral considerations are involved in spending so much money on science? Which science would be justified? Science needs cultural support which values the search for knowledge, even if it is not profitable in a direct sense.

It may be questioned whether such ethical issues are within the province of religion. It is not only science which has emancipated itself from religion in modern times, but ethics and politics too. In Western, liberal societies various religious traditions co-exist under a large umbrella of allegiance to public laws and procedures and to a general set of human rights and human values. Religion has lost its grip on the public realm, but also on the private realm, where increasing numbers of people tend to base their choices on their own preferences or decisions rather than on allegiance to some religiously prescribed set of behavioural codes. The contribution of religion should, perhaps, be located at a deeper level, in the underlying existential attitude. For example, in discussing medical ethics one comes across views regarding human finitude and death. Are we willing to accept finitude? And how do 'life' and 'quality of life' count? Thus, from ethics one enters into a domain of existential questions.

It is not clear whether ethics is itself a safe niche for religion, as ethics too has been approached in a naturalist way, for example by Richard Alexander in *The Biology of Moral Systems* (Alexander 1987). However, even if all actual ethical systems are to be seen as strategies within specific cultures, they nonetheless may be taken to suggest absolute values as a kind of transcendental regulative idea beyond all cultural differences. Such absolute values are not available. This feature should keep us from fanaticism (Sutherland 1984). Whether we can say that these absolute values exist is strongly dependent upon the notion of 'existence'. It will not be like the existence of tables and chairs, nor that of electrons and magnetic monopoles. An analogy with mathematics might be more fruitful. Mathematics exists as far as it has been developed by humans, written down in textbooks and articles.

However, it does not seem as arbitrary as most human artefacts, such as literature. Mathematical theorems seem to have a truth which precedes their discovery.

The last option to be considered is a niche *above the naturalist account*. As the contribution by Paul Davies in this volume shows, one might ask various questions about the scientific descriptions as a whole. As Ernan McMullin wrote (1988, p. 74): 'The appeal is not to a "gap" in scientific explanation but to a different order of explanation that leaves scientific explanation intact, that explores the possibility for there being *any* kind of explanation'. This does not offer an argument for the existence of God within the context of science, as it is that context itself which is the focus of philosophical reflection. Introducing the notion 'God' in this context is not really an answer, an explanation for the Universe or for God. It points to an open place and keeps us aware of the questions.

McMullin and Davies agree in reflecting upon the whole of the scientific enterprise rather than upon apparent gaps within a scientific account. If a sense of wonder, reverence or the like is sufficient to qualify someone as religious, then both are religious. However, the normative and ritual aspects of religion are missing from the approach of Davies. McMullin maintains a richer notion of religion by taking seriously the religious tradition as it arose in Israel. As he formulates it, 'God is not to be seen *in* the universe, then, but *through* it' (McMullin 1988, p. 59). Mary Hesse, in this volume, aligns more with McMullin when she emphasizes actual human practices and traditions. She does not offer an argument for God for those taking a standpoint outside a specific tradition. Rather than looking for scientific contributions to a metaphysical theology of nature in the traditional sense, she holds it to be more fruitful to regard these reflections on science as 'debates about an appropriate *language* for theology, and a source of appropriate *models*' (Hesse 1981, p. 287).

Hesse and Davies address different questions, but neither of them addresses the agenda of the other in his or her own terms. This confirms the claim in the first paragraph of this contribution: discussions in science and religion are not merely discussions about answers, but

also disagreements about the problems, and hence about the questions. The difference between Davies and Hesse also points to a problem with the various niches described above. One might take seriously the idea of some cosmic God beyond the naturalistic account, along the lines suggested by Davies, but would one ever light a candle to such a God? And if one takes the phenomenon of religion seriously as an important human practice, as does Hesse, one is in danger of ending with a religion without referent, a religion without God. How is one ever to combine such different strands and the transcendental regulative idea of absolute value?

Notes

1. *U.S. News and World Report*, 23 December 1991, p. 59.
2. For Galileo's use of Scripture, see McMullin (1981); for a more socio-political emphasis, see de Santillana (1955); Copernicanism and exegesis are central to Langford (1966), e.g. pp. 65 ff.
3. Translated in S. Drake, *Discoveries and Opinions of Galileo* (New York: Doubleday, 1957); quotations have been taken from pp. 197 (twice), 186 and 187.
4. For instance, Surin (1986) rejects a theoretical theodicy. One should ask what we as God's creatures do to overcome evil and suffering rather than ask whether existence of an omnipotent and loving God and the amount of evil and suffering are compatible.
5. As the Dutch philosopher of religion Vincent Brümmer argued during the conference on which this book is based.

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