species of inconsistency. And this understanding is reasonable, since contrary claims imply the presence of contradiction. The application of this (broad) principle to a set of propositions (truth-claims) has only two possible outcomes. First, the set can be shown to be logically consistent, and therefore possibly true (consistency does not guarantee truth). Secondly, and much more significantly, the set can be shown to be logically inconsistent, and therefore *actually false* (inconsistency guarantees falsehood). (For fuller discussions of this issue, see Bradley and Swartz, *Possible Worlds*, pp. 28–30, and Nash, *Worldviews*, pp. 55–57.)

The use of non-contradiction in apologetics

In apologetics the primary use of the principle of non-contradiction is to show that the set of propositions comprising the core beliefs of the Christian faith is logically consistent and therefore possibly true. This cannot be done without first showing that particular Christian beliefs are internally consistent. Richard Swinburne, for instance, argues for the coherence of the theistic concept of God, where 'coherence' is a broad concept that embraces logical consistency and conceivability (see Swinburne, *Coherence*, pp. 11–14). For Swinburne a coherent statement may be false but may be true. If the concept of God is coherent, then it is internally consistent and therefore possibly true. If each core Christian belief is internally consistent, and if all these beliefs form a logically consistent set, then it is possible that the Christian faith is true.

Making a case for the possible truth of the Christian faith falls short of completing the task of apologetics. So to take things further, some apologists combine the principle of non-contradiction with an appeal to the facts of experience to form a test of 'systematic consistency' to argue that the Christian faith is *actually* true (see Carnell, *Introduction*, pp. 56–62, and Craig, *Apologetics*, pp. 22, 196.) They maintain that Christianity is logically consistent and fits all the facts of experience, and therefore it is highly probable that it is true.

Objections to the principle of non-contradiction

Despite its place in the foundations of logic and metaphysics, the principle of non-contradiction has been subjected to vigorous criticism. Christian thinkers are the source for some of this, but the most radical criticism comes from thinkers influenced by Eastern thought.

Objections from theology

Some Christian theologians have objected to the application of the principle of non-contradiction to thinking and speaking about God. These theologians have not rejected the principle itself, but have insisted that it cannot be used with reference to God, for God (they say) is 'beyond logic' or 'has a logic of his own'. Although this type of objection has a link to the generally accepted proposition that no-one could have exhaustive knowledge of God, it is not entailed by that proposition and it has the consequence of being fatal to all thinking and speaking about God. For if the principle of non-contradiction does not apply to God, then both any assertion about God, and that assertion's contradictory, could be true (e.g. 'God is love' and 'God is not love'). Not only *theology but the whole of Christian faith and life require the principle of non-contradiction to apply to God. (For a helpful discussion of this, with examples from the work of these theologians, see Nash, *Worldviews*, pp. 74–80.)

Objections from Eastern thought

Typically, Eastern thought (e.g. Hindu, Buddhist and Taoist) maintains that reality transcends all distinctions, including the logical distinctions embedded in the principle of non-contradiction. Proponents of Eastern thought respond to the call for logical consistency (*Aristotle's 'X *or* not X') with a provocative picture of a world in which the concept of logical consistency impedes seeing the world as it really is (the Buddha's 'X *and* not X'). An interesting contemporary application of this Eastern rejection of logical consistency is the development of 'fuzzy logic', which is based on the 'fuzzy principle' that everything is a matter of degree. The fuzzy principle has been put to use in creating powerful new forms of technology that outstrip the performance of older forms based on the black-and-white logic of non-contradiction. Critics of fuzzy logic have said that it is nothing more than an alternative way to express and harness the old concept of probability. Perhaps that criticism is correct. But a more impressive form of criticism is within reach of anyone who reads something by a proponent of fuzzy logic. The reader will discover, in its 'fuzzy' pages, an implicit and pervasive use of the principle of non-contradiction.

Bibliography

R. Bradley and N. Swartz, *Possible Worlds: An Introduction to Logic and Its Philosophy* (Indianapolis, 1979); J. Cargile, 'Classical Logic – Traditional and Modern', in J. H. Fetzer (ed.), *Principles of Philosophical Reasoning* (Totowa, 1984); E. J. Carnell, *An Introduction to Christian Apologetics* (Grand Rapids, 1948); L. J. Cohen, 'Rationality', in J. Dancy and E. Sosa (eds.), *A Companion to Epistemology* (Oxford, 1992); W. L. Craig, *Apologetics: An Introduction* (Chicago, 1984); B. Kosko, *Fuzzy Thinking: The New Science of Fuzzy Logic* (New York, 1993); R. H. Nash, *Worldviews in Conflict: Choosing Christianity in a World of Ideas* (Grand Rapids, 1992); R. Swinburne, *The Coherence of Theism* (Oxford, 1977); S. Wolfram, *Philosophical Logic: An Introduction* (London and New York, 1989).

D. M. Ciocchi

COSMOLOGICAL ARGUMENT

The cosmological argument is a family of arguments which seek to demonstrate the existence of a 'sufficient reason' or 'first cause' of the existence of the cosmos. They can be grouped into three basic types: the *kalam* cosmological argument for a first cause of the beginning of the universe, the Thomist cosmological argument for a sustaining ground of being of the world, and the *Leibnizian cosmological argument for a sufficient reason why something exists rather than nothing.

A simple statement of a Leibnizian cosmological argument might run as follows: every existing thing has an explanation of its existence, either in the necessity of its own nature or in an external cause; if the universe has an explanation of its existence, that explanation is God; the universe is an existing thing; therefore, the explanation of the existence of the universe is God.

One of the main objections to Leibniz's own formulation of the argument is that it presupposes his principle of sufficient reason that 'no fact can be real or existent, no statement true, unless there be a sufficient reason why it is so and not otherwise'. Many have doubted this principle. Some theists have responded to this objection by agreeing that one must ultimately come to some explanatory stopping point which is a being whose existence is a brute, contingent fact, and that God is a simpler stopping point than the variegated and finite universe. The formulation of the Leibnizian argument given above, however, avoids the objection without retreating to the dubious position that God is a contingent being, as it merely requires any existing *thing* to have an explanation of its existence, either in the necessity of its own nature or in some external cause. This is compatible with there being brute *facts* about the world. What it precludes is that there could be things which just exist inexplicably. This principle seems quite plausible, which is all that is required for a successful argument.

Atheists implicitly endorse the second premise of the argument that 'if the universe has an explanation of its existence that explanation is God'. For they typically assert that, there being no God, it is false that everything has an explanation of its existence because the universe just exists inexplicably. In so saying, the atheist implicitly recognizes that if the universe has an explanation, then God exists as its explanatory ground. Since the universe is obviously an existing thing (especially evident in its very early stages when its density was so extreme), it follows that God exists.

It is open to the atheist to retort that while the universe has an explanation of its existence, that explanation lies not in an external ground but in the necessity of its own nature. In other words, the universe is a metaphysically necessary being. This is an extremely bold suggestion, as we have a strong intuition of the universe's contingency. Still, it would be desirable to have some stronger argument for the universe's contingency than our intuitions alone. Could the Thomist cosmological argument help us here? In *Thomas Aquinas' Aristotelian-inspired metaphysic, every existing finite thing is composed of a nature and an act of being which instantiates that nature. They are, therefore, radically contingent upon a ground of being whose essence is being itself. If successful, the Thomist argument would show that the universe is a contingent entity causally dependent upon a necessary being for its continued existence. The problem with appeal to the Thomist argument, however, is that it is very difficult to show that things are, in fact, contingent in the special sense required by

the argument. Certainly, things are naturally contingent in that their continued existence is dependent upon a myriad of factors including temperature, pressure, entropy level and so forth, but this natural contingency does not suffice to establish a metaphysical contingency in the sense that being must continually be added to their natures or they will be spontaneously annihilated.

Can the *kalam* cosmological argument come to our assistance here? It holds that an essential property of a metaphysically necessary and ultimate being is that it be eternal, i.e. without beginning or end. If the universe is not eternal, then it could not be a metaphysically necessary being. But it is precisely the aim of the *kalam* argument to show that the universe is not eternal but had a beginning. It would follow that the universe must therefore be contingent in its existence. More thatn that, the *kalam* argument also shows the universe to be contingent in a very special way: it came into existence out of nothing. The atheist who would answer Leibniz by holding that the existence of the universe is a brute fact, an exception to the principle of sufficient reason, is thus thrust into the very awkward position of maintaining not merely that the universe exists eternally without explanation, but that for no reason at all it magically popped into being out of nothing. This position might make *theism look like a welcome alternative. Thus, the *kalam* argument not only constitutes an independent argument for a transcendent creator but also serves as a valuable supplement to the Leibnizian argument.

The *kalam* cosmological argument may be formulated as follows: whatever begins to exist has a cause; the universe began to exist; therefore, the universe has a cause. Conceptual analysis of what it means to be a cause of the universe then aims to establish some of the theologically significant properties of this being.

The first premise seems obviously true at least, more so than its negation. It is rooted in the metaphysical intuition that something cannot come into being from nothing. Moreover, this premise is constantly confirmed in our experience. The second premise has been supported by both deductive, philosophical arguments and inductive, scientific arguments. Philosophically, various arguments have been offered to show the metaphysical impossibility of an infinite temporal series of past events. For example, the existence of an actually (as opposed to merely potentially) infinite number of things leads to counter-intuituive absurdities and even self-contradictions, e.g. what is infinity minus infinity? Mathematically, inverse operations like subtraction are not defined for infinite quantities because one obtains contradictory answers. For example, if one subtracts all the odd numbers (1, 3, 5 ...) from all the natural numbers (0, 1, 2, 3 ...), then an infinite number of numbers is left over (so infinity minus infinity is infinity); but if one subtracts all the numbers greater than 2, one has only three numbers remaining (so infinity minus infinity is three!). It needs to be understood that in both these cases one has subtracted identical quantities from identical quantities and come up with contradictory answers. In fact, one can get any answer one pleases from zero to infinity. This suggests that however fruitful and consistent a concept the actual infinite may be within the universe of discourse created by the axioms and conventions of infinite set theory and transfinite arithmetic, it cannot be transposed into the spatio-temporal world. But since a beginningless series of past events would entail an infinite number of past events, it therefore follows that the series of past events is finite and that the universe began to exist.

Or again, it might be argued that it is impossible to form such an actually infinite collection by adding one member at a time. Sometimes this is described as the impossibility of traversing the infinite. In order for us to have 'arrived' at today, temporal existence has, so to speak, traversed an infinite number of prior events. But before the present event could arrive, the event immediately prior to it would have had to arrive; and before that event could have arrived, the event immediately prior to it would have had to arrive, and so on *ad infinitum*. No event could ever arrive, since there will always be one more event that had to have happened first. Thus, if the series of past events were beginningless, the present event could not have arrived, which is absurd. If one insists that given infinite past time, the present event would have arrived, one is faced with the deeper question of why the present event did not occur yesterday or the day before, since by then an infinite amount of time had already elapsed. In fact, no matter how far back into the past one regresses, it seems that the event in question would have already arrived, which is also absurd.

Scientifically, contemporary interest in the *kalam* cosmological argument arises largely out of the startling empirical evidence of astrophysical cosmology for a beginning of space and time. The standard 'Big Bang' model, which has been the controlling paradigm of contemporary cosmology for the last seventy years, describes a universe which is not eternal in the past, but which came into being a finite time ago. Moreover, the origin it posits is an absolute origin *ex nihilo*. For not only all matter and energy, but space and time themselves come into being at the initial cosmological singularity. Sometimes objectors appeal to non-standard models of the expanding universe in an attempt to avert the absolute beginning predicted by the standard model; but it has been the overwhelming verdict of the scientific community that none of these is more probable than the Big Bang theory. The devil is in the details, and when one examines such senarios closely, one finds that there is no mathematically consistent model which has been so successful in its predictions, or as corroborated by the evidence, as the traditional Big Bang theory. For example, some theories, like the oscillating universe (which expands and re-contracts forever), the chaotic inflationary universe (which continually spawns new universes) or the cyclic ekpyrotic model (which involves periodically colliding three-dimensional membranes in a five-dimensional spacetime), may have a potentially infinite future but turn out to have only a finite past. Vacuum fluctuation universe theories (which postulate an eternal vacuum out of which our universe is born) cannot explain why, if the vacuum was eternal, we do not observe an infinitely old universe. The quantum gravity universe theory propounded by the famous physicist Stephen Hawking, if interpreted realistically, still involves an absolute origin of the universe even if the universe does not begin in a singularity, as it does in the standard Big Bang theory. In sum, according to Hawking, 'Almost everyone now believes that the universe, and *time itself*, had a beginning at the Big Bang' (S. Hawking, *The Nature of Space and Time* [Princeton, 1996], p. 20).

A second scientific consideration concerns the thermodynamic properties of the universe. According to the second law of thermodynamics, processes taking place in a closed system always tend toward a state of equilibrium. Now the universe is, on a naturalistic view, a gigantic closed system, since it is everything there is and there is nothing outside it. What this seems to imply is that, given enough time, the universe and all its processes will run down, and the entire universe will come to a state of heat death. Once the universe reaches this state, no further change is possible.

Now the question that arises is this: if given enough time the universe will reach heat death, then why is it not in a state of heat death now, if it has existed forever, from eternity? If the universe did not begin to exist, then it should now be cold, dark, dilute and dead. Some people have tried to escape this conclusion by adopting an oscillating model of the universe which never reaches a final state of equilibrium. But the thermodynamic properties of this model imply the very beginning of the universe that its proponents sought to avoid. For entropy increases from cycle to cycle in such a model, which has the effect of generating larger and longer oscillations with each successive cycle. Thus, as one traces the oscillations back in time, they become progressively smaller until one reaches a first and smallest oscillation. In fact, it is estimated on the basis of current entropy levels that the universe cannot have gone through more than 100 previous oscillations. The universe appears to have been created a finite time ago, and its energy was somehow simply put in at the creation as an initial condition.

It follows, therefore, that the universe has a cause. Conceptual analysis enables us to recover a number of striking properties which must be possessed by such an ultra-mundane being. For as the cause of space and time, this entity must transcend space and time and therefore exist atemporally and non-spatially, at least without the universe. This transcendent cause must, therefore, be changeless and immaterial, since timelessness entails changelessness, and changelessness implies immateriality. Such a cause must be beginningless and uncaused, at least in the sense of lacking any antecedent causal conditions. This entity must be unimaginably powerful, since it created the universe without any material cause.

Finally, and most remarkably, such a transcendent cause is plausibly to be taken to be personal. Three reasons can be given for this conclusion. First, there are two types of causal explanation: scientific explanations in terms of laws and initial conditions and personal explanations in terms of agents and their volitions. A first state of the universe *cannot* have a

scientific explanation, since there is nothing before it, and therefore it can be accounted for only in terms of a personal explanation. Secondly, the personhood of the cause of the universe is implied by its timelessness and immateriality, since the only entities we know of which can possess such properties are either minds or abstract objects. As abstract objects do not stand in causal relations, the transcendent cause of the origin of the universe must be of the order of mind. Thirdly, this same conclusion is also implied by the fact that we have in this case the origin of a temporal effect from a timeless cause. If the cause of the origin of the universe were an impersonal set of conditions, it would be impossible for the cause to exist without its effect. For if the sufficient conditions of the effect are timelessly given, then their effect must be given as well. The only way for the cause to be timeless and changeless but for its effect to originate anew a finite time ago is for the cause to be a personal agent who freely chooses to bring about an effect without antecedent determining conditions. Thus, we are brought, not merely to a transcendent cause of the universe, but to its personal Creator. He is, as Leibniz maintained, the sufficient reason why anything exists rather than nothing.

Bibliography

W. D. Beck, 'The Cosmological Argument: A Current Bibliographical Appraisal', *Philosophia Christi*, 2 (2000), pp. 283–304; D. R. Burrill, *The Cosmological Arguments* (Garden City, 1967); W. L. Craig and Q. Smith, *Theism, Atheism, and Big Bang Cosmology* (Oxford, 1993); S. Wallace (ed.), *Does God Exist?* (Aldershot, 2003).

W. L. Craig

COSMOLOGY

It is fundamental to biblical theology that the universe owes its origin and continued existence to the will of God. The God supremely and uniquely revealed in Jesus, is the creator and sustainer of heaven and earth. Christian apologetics has therefore asked how can the scientific and biblical accounts of the origin of the universe be held together, as God is the Lord of both his works and his word. Further, are there insights from the world of *science which point towards the existence of a Creator, or provide possible bridges for dialogue between those who are not Christians and the Christian faith?

Within the scientific community, it is generally agreed, on the basis of the redshift of galaxies, the observation of the microwave background radiation and the theoretical prediction of the observed hydrogen-to-helium ratio, that the origin of the universe is well described by the model of the hot Big Bang, with the universe expanding from a singularity some twelve billion years ago. Of course, no scientific model is without its problems, and the Big Bang leaves certain questions unanswered, such as the nature of the dark matter which is necessary for galaxy formation. Although the model of the Big Bang has needed some careful refining, it has stood up remarkably well to over thirty years of scrutiny and new observations.

In terms of the biblical account, the fundamental principles of Gen. 1 (which are reflected in many other biblical passages which deal with creation) are that God is the sole and sovereign Creator of all things and the source of order and extravagance in the universe, and that human beings are the highpoint of his creative activity by virtue of his gift of intimate relationship and responsibility.

It is important to note that the Bible is not interested in cosmology for its own sake. The biblical teaching about creation is located in passages which are concerned with other issues such as worship, Christology and salvation. Some knowledge of this Creator God can be seen in his works of creation, but his nature is supremely revealed in *Jesus who is the image of the invisible God and is involved with the Father and the Spirit in the work of creation (Col. 1:15). Christ is the one in whom the universe is created, sustained and finds its ultimate consummation. Therefore, Christians have understood science in Kepler's words of 'thinking God's thoughts after Him' and as being a Christian calling. Indeed, many historians of science point out the positive influence of Christian theology upon the growth of modern science.

Big Bang or Big God?

Although all Christians agree that God is the source and sustainer of the whole universe, there is disagreement on how he creates. A great deal of Christian apologetic effort has been given to reconciling the scientific account of origins with the biblical account, and a diversity of approaches have been offered.

In the nineteenth century, Thomas Chalmers proposed the 'gap theory', which suggested a gap between the first two verses of Gen. 1, the verses referring to a creation and then recreation. Hugh *Miller argued that the 'days' of Gen. 1 represent periods of time. In the twentieth century, P. J. Wiseman suggested that the 'days' of Gen. 1 were not days of creation but days of revelation, that is days when God 'revealed' his creation to Adam. These approaches attempted to reconcile the scientific age of the universe of billions of years with the Genesis chronology, and they still have their adherents today.

More influential within the evangelical community, however, are two competing interpretations. Scientific creationism argues that an acceptance of the Big Bang is incompatible with a Creator God. Proponents of this position point out scientific gaps in the Big Bang model; argue for an age of the universe in thousands rather than billions of years; claim that the early chapters of Genesis are a scientific account of the origin of the universe; and see God as more likely to create in seven days rather than over billions of years.

Within scientific creationism itself there is a diversity of positions. Some suggest that God created the universe to look billions of years old, while in fact its age is only thousands of years. Others suggest that the universe is billions of years old, but the earth was created specially by God a few thousand years ago.

Theistic evolution claims that the early chapters of Genesis are not scientific history but belong to the genre of theological or liturgical literature. The vast amount of scientific evidence for the Big Bang theory and an age of the universe of billions of years are stressed, and God is seen as using the long process of cosmological history to further demonstrate his glory. The scientific model of the Big Bang is therefore to be held together with the theological truth that the whole creation owes its existence to God. Both are needed fully to understand its origin.

There is real diversity on this issue among believers equally committed to the authority of the Bible. There are scientific arguments to be debated, such as the age of the universe, but the issue is one primarily of biblical interpretation. That is, are the early chapters of Genesis meant to be a scientific history of the universe or is their purpose primarily theological? Here apologetics, as always, has to show integrity to our experience of God's world and to the most faithful interpretation of God's Word.

An absence of God?

In recent years, another aspect of apologetics within the area of cosmology has been highlighted. The popularity of Stephen Hawking's *A Brief History of Time* has raised questions to a wider audience about whether science rules out a Creator God.

Hawking has suggested a possible solution to a fundamental problem with the Big Bang, that of 'what happened at the first moment?' Cosmology uses its knowledge of the physical laws to reconstruct a model of what happened in the past. In this it has been extremely successful with our current models describing the universe well back to a time when it was only 10^{-43} second old. At that point current theories break down, due to an inconsistency between general relativity and quantum theory, and therefore a description of the initial conditions of the expansion of the universe is beyond our reach. If science is unable to describe the initial moments of the universe, is this where God comes in?

What Hawking does is to suggest a possible way of uniting quantum theory and gravity (the realm of general relativity) to describe the beginning of the universe. One of the results of this is that he describes how the blue touch paper of the Big Bang lights itself. Hawking is saying that the universe does have a beginning, but it does not need a cause, for Hawking's universe emerges from a fluctuation in a quantum field. No cause as such is necessary.

There are many scientific difficulties with Hawking's theory, and it is not widely accepted. There are other proposals on how to deal with the problem of the laws breaking down. In addition, Hawking actually does not have a full theory; he makes his suggestions on the basis of this is what the theory would look like if he had a full theory. Further, it is difficult to know whether quantum theory can be legitimately applied to the whole universe.

Yet it raises some important theological questions. If Hawking is right, does God become redundant? Is Carl *Sagan right to describe Hawking's book as a book about the 'absence of God'? We need to be clear that Hawking questions the cosmological argument in temporal form. The universe may have a