betrays a naïve realist position; substantive realism is much more subtle than that. In attempting to expound what it is to be a realist logical constant, Christopher Peacocke (1988) argues that a realist is one who allows that a sentence or content can be true though (a subset of which may be) unverifiable by us; certainly, however, there are doubtless many false unverifiable propositions.

Is infinity realistic?

These modest points permit us to have the standpoint that our explanatory capabilities do not in principle fall short of our being able to represent features of infinity and a realist God who is unverifiable. Adjacent to this state of affairs is a group of concepts concerning the presumed beginning of the universe. Infinity conditions seem to have applied to all phenomena which comprise the commencement of this universe, and possibly all others if the Rees (1997) multiverse hypothesis holds true. If Hawking and Turok (1998: 8) are correct, then the multiverse hypothesis gives way to an open universe which is spatially infinite or a closed universe which is finite (and on one interpretation the latter is the only universe). Obviously, since there are different sorts of infinity, it does not follow from whatever the initial infinity conditions were in, say, the big bang, that these are identical to divine transcendent infinities. But given the inter-derivability of mathematical and logic infinities (including transfinite set theory), of which we do have some mastery, together with either their tautological relations and/or live metaphoric relations to other transcendent infinities, it appears that we should be able in principle to use one group of infinities as a thought-bridge to achieve knowledge of other infinities.

If the sort of infinity of which we have some knowledge has a relevant relation to the infinity that is a property of God, if God exists, then we should in principle be able eventually to discover enough about inference of infinities to handle a relevant range of propositions about God. Cantor's less popular contribution to this topic was his view that mathematical infinity is a function of facets of God's mind. It seems presumptuous to adopt this as a mathematical truth, though the mysteries in pure mathematics are not exhausted by an explanation of higher mathematics that is restricted to the construction of mathematical calculus from finite experience.[1]

Was there always infinity?

If God exists, a bedrock block between the universe and God is the structure of finite spacetime. God is said to be infinite, whilst traditionally the universe is finite. But there have been developments in cosmology to enlarge the scope of physical infinity's range of application that either overlaps with traditional notions of God's function or reduces God's functional purview of the material universe, which has its rough counterpart in relations

between organic evolution theory and creation at some levels. Deutsch proposes a fresh version of the many-worlds universe in which there is an infinite series of universes with increasing variation.[2] It might be argued that the multiverse option of an infinite group of universes has already undermined a finite beginning to everything physical from other angles. But it does not have to follow from such a scenario that the series always existed, only that it continues, especially if one modifies Hawking and Turok's (1998) thesis where matter-radiation happened at a red shift of 100. So this does not have to be a genuine temporally symmetrical infinity. On this type of interpretation, Deutsch's thesis is a barrier to committing one to the question of: from where did everything come?

Is mystery a feature of our ignorance?

When addressing some issue concerning why the universe displays asymmetries and exploring how this pertains to the notion of an infinite past, Rees (1997: 226–67) explains that some of the universe's current effects are counter-intuitive, choosing the example of gravity (in which certain things accelerate when they might be expected to slow down). He observes that in tracing such states of affairs back to the conjectured ultradense primal beginning, cosmologists are faced with matters that are mysterious. That there are mysterious asymmetries, which question the eternal past regress of the universe, is clear. Some scientists will prefer to assign this asymmetry to a conjectured physical solution that dissolves the mystery; entropy seems to oppose this prospect, though others suggest ways around the difficulty. A response is that since the empirical evidence and proof are not currently available for this dismissal, it could be the case that the proposal is incorrect. There we are faced with a false attempt to derive infinity from finite resources which even when recycled are still finite and entropic – for example, by following possible lines opened up by Hawking and Turok (1998). In this perspective we need an explanation of what the first cause was, despite a willingness to delay it over a regress on a multiverse or many-world universe, which eventually retroject back to a standstill before which there was no prior world. Given the restoration of causality by the universal wavefunction in versions of the many-world thesis, this standstill is an effect for which a universal cause is contingently needed.

Are there foundations to space?

A 'manifold' is the syntax from which geometry or topology is crafted – the bedrock beyond which there is no more fundamental formalism or system of physical relational ontology. The underlying structure of the continuity perceived between space and time is formalised be the concept of manifold, i.e. the bedrock space or surface of the universe and its parts. As Hawking and Ellis (1973) stated: 'a manifold is essentially a space which is locally

similar to Euclidean space in that it can be covered by co-ordinate patches'. Hawking points out that the sort of manifold which he is discussing (a Hausdorff space) does not necessarily have to be disjointed. Consider the possibility that there is a universal manifold continuous with this universe and God (in a way which suitably preserves contrasts). In Hawking's interpretation, different co-ordinate systems can exist in the one manifold. As far as we know there is no algorithm for four-dimensional topology equivalence, i.e. no theorem for deciding how all cases of forms deform or blend into other forms.[3] So it is presumptuous to suppose that there is no access point from another *kosmos*; so the co-ordinate systems in God's other 'universe' and this universe, or multiverse, can consistently be different, yet share one underlying counter-intuitive complex manifold.

This brings us to the edges of the fast-moving current development in an exotic branch of pure mathematics concerning manifolds and knot theory, a topic which can only be briefly aired here.[4] Mathematics of manifolds have theorems that imply that new manifolds can be constructed out of prior ones, as Cappell, Ranicki and Rosenberg (2000a: 9–15) explain. This is called surgery theory – largely initiated by Wall (1999). Using a theory about a spherical spaceform problem, a theorem has been devised to link infinite groups with finite quotients using a representation theory (see Stark 2000). A closed finite manifold may be opened up like a book to yield routes to infinite groups, as Winkelnkemper (1998) proves. Now, at least from these standpoints of pure mathematics, we have a complex model for a mathematical rationality that facilitates a connection between finite and infinite domains, with criteria for assessing their borders and mapping the connections between them.

Some people may find this unappealing as a way of assessing talk about routes to God. But for those who allege that there is no logical or scientific support for handling the logic of discourse about a transcendent divinity, because of limits to scientific language, the foregoing is fundamental: they are simply wrong. The higher levels of such pure mathematics are the province of what increasingly physics and astrophysical cosmology takes up as the theoretical basis for modelling the empirical world. Although we may deem these areas speculative, they are mathematics that work, and are an inferentially derived set of theorems that follow from established mathematics, not merely from ungrounded imagination. There are grounds for accepting them as conceptually secure, as are domains of applied mathematics, and some of them are already finding applications in advanced physics. In other words, surgery theory satisfies a number of conditions to be considered formalism that maps empirical possibility, not just speculative probability. I suggest that these developments, though they present major problems of interpretations, can be taken as quantifiable live metaphors to structure a breakthrough in our grasp of spacetimes, and the bedrock manifold of our physical universe, so as to model some conditions for exposing properties of a non-empirical yet ontological infinity. The traditional idea of a mechanistic universe whose theorisation is in principle unable theoretically

to move beyond materialism into characterising properties of infinity died with the emergence of such surgery and knot mathematics, as well as empirical concepts of the infinite velocity of light, of energy and matter density, and the like. So what was regarded in Hawking and Ellis's (1973) earlier cosmology as the basic foundation on which spacetime was built – the manifold, now turns out to be only an arbitrary resting-place. Once the knots in it are untied and mathematically mapped, reconstructive surgery can be done to find a route to infinity. Bertrand Russell wanted to reduce mathematics to logic. He got it the wrong way around: logic has to transcend to the level of pure mathematics, aesthetics and cosmology to infinity.

There are also already observational and theoretical conclusions which at least stretch the concept of a fixed manifold to limits which question its empirical limit or basis, and the current versions of its theoretical foundations. The Cavalière *et al.* conception, of black hole remnants that are driven by gravitational power, could be extended and integrated with an eleven-dimensional superstring gravitational coupling in M-theory (cf. Polchinski 1998: 198–99). Cremmer (1982) argues that the supergravity in similar situations has hidden symmetries which indicate a (manifold of) five-dimensional series in its mass parameters; for example, those symmetries which break off unpredictably.

Does space have breakdowns?

Hawking supposes that the breakdown of his manifold formulation would occur if there were a density of 10^{58}gm cm^{-3}. We have no physical or experimental comprehension of what it would be for such a state of affairs to hold – though it is implied by some present theories. Stemming from the research of Edward Witten, and others such as Michael Greene,[5] superstring and M-theory show that spacetime can be torn in 11- (or 11-plus) dimensional supergravity; this amounts to the prospect of a future understanding of how the universe and other spacetimes, as well as (on my interpretation) some other discontinuous domain which has infinity functions could be coupled together through such a tear without physical cataclysm. There is no reason why this could not be used as a metaphor for divine relations. Since such a breakdown of local physics is implied by the astrophysical theories, it eventually follows that this is not a collapse of the manifolds in principle, but solely the manifolds which intuitively account for the universe as it presently seems to manifest itself at empirically observable levels to us. The manifold for this universe cannot be appealed to as *the* fundamental unalterable functional frame, because, in principle for observational cosmology, there is a density at which they collapse. Hence, this universe's manifolds only hold the status of a type of contingent metalanguage for various co-ordinate object-languages, and the situation admits of the possibility that underlying this manifold is a more fundamental transcendental manifold(s) which is not reducible to this universe's manifold.