Science, Religion and Infinity

Oppy (2006) contains an extensive discussion of the understanding and application of a conception of the infinite that is fundamentally mathematical: questions about the mathematically infinite are questions about the cardinality of collections, or the divisibility of time and space, or about the magnitude of measurable properties, and so forth. But—following the discussion of Anaximander and other early philosophers—we might wonder whether the discussion of the mathematically infinite really does exhaust the discussion of the infinite. Is it the case that the concept of the infinite is, in all essentials, the concept of the mathematically infinite—or is it rather the case that the concept of the infinite is importantly ambiguous in such a way that we can also discern something that might properly be called a non-mathematical conception of the infinite? In order to address this question, I shall largely follow the lead of Sweeney (1992), which surveys the range of attributions of 'infinity' to monotheistic gods.

1. Brief History

Etymologically, 'infinite' comes from the Latin 'infinitas': 'in' = 'not', and 'finis' = 'end', 'boundary', 'limit', 'termination', 'determining factor', etc. So, to be 'infinite' is to be not possessed of an end, or boundary, or limit, or termination, or determining factor. There are two Greek terms—*apeiria* and *aoristia*—that are at least sometimes translated using the word 'infinite'. Etymologically, to be 'apeiria' is to be in the state of having no end, or limit, or boundary; whereas to be 'aoristia' is to be without boundary, measure, decision, determination, and so forth. According to Sweeney's—perhaps controversial—interpretation, 'apeiria' can signify either absence of determination and form, or presence of infinite power, whereas 'aoristia' only signifies absence of determination because of absence of form.

1.1 <u>Anaximander</u>: As just noted, the origins of our words 'infinite' and 'infinity' can be traced back to the Greek word *peras* (πέρας), which can be translated by 'limit', or 'bound', or 'frontier', or 'border', and which has connotations of being 'clear' or 'definite'. The Greek word *to apeiron* (άπειρον)—the 'negation' or 'opposite' of *peras*—thus can be understood to refer to that which is unlimited, or boundless, or—in some cases—unclear and indefinite.

When the word *to apeiron* makes its first significant recorded appearance—in the work of Anaximander of Miletus[1]—it is typically taken to be used to refer to 'the boundless, imperishable, ultimate source of everything that is' (Moore (1998:772). Thus, in this early usage, the word *to apeiron* has connotations—'imperishable', 'ultimate source of everything'—that are quite separate—or, at any rate, separable—from considerations about the absence of 'limits', or 'bounds', or 'frontiers', or 'borders', or 'clarity' or 'definiteness'.

As Moore (1998:773) points out, most of the Greeks associated much more negative connotations with *to apeiron* than are evident in the early usage of Anaximander: for the Pythagoreans, and—at least to some extent, for Plato—*to apeiron* 'subsumed … all that was bad …; it was the imposition of limits on the unlimited that accounted for all the numerically definite phenomena that surround us'. Again, on this kind of usage of the term, *to apeiron* has connotations—'chaotic', 'irrational', 'disorderly'—that are

quite separate—or, at any rate, separable—from considerations about the absence of 'limits', or 'bounds', or 'frontiers', or 'borders', or 'clarity' or 'definiteness'.

1.2 <u>Aristotle</u>: As with so many topics, the first systematic treatment of infinity that we have is found in Aristotle. There is discussion of the infinite in at least the following Aristotelian texts: *Physics* III, 4-8. 10; *Metaphysics* K, 10; *Metaphysics* L, 7; and *Concerning the Heavens* I, 5-7. Of these, the most important discussion is that in the *Physics*, where it seems that Aristotle divides that which can properly be said to be infinite into the following three categories: (i) that which is 'intrinsically' 'intraversable'—e.g. a point or a quality; (ii) that which is 'intrinsically' 'traversable', but in which the process of 'traversal' is 'extrinsically' or 'metaphorically' 'endless'—e.g. the depth of the sea or a journey to Alpha Centauri; and (iii) that which is 'intrinsically' 'traversable', and in which the process of 'traversal' is itself 'intrinsically' 'endless' either with respect to 'addition'—e.g. the natural numbers— or with respect to 'division'—e.g. a finite volume of space—or with respect to both 'addition' and 'division'—e.g. time. Of these three categories, it is really only the last that can properly be said to deserve the label 'infinite'—and, as many commentators have stressed, in this case we have a mathematical and quantitative concept of the infinite. Indeed, if we eliminate 'traversability' in favour of 'measurability'—thus dispensing with the metaphor of travel in favour of the more abstract and precise notion of measure—and then eliminate the notion of 'measurability' in favour of the notion of 'being possessed of finite measure'—thus dispensing with the ambiguous modal notion (measurable by whom?) in favour of an unambiguous non-modal notion—we arrive at what is plausibly the generic modern conception of the infinite: *that which exceeds all finite measure*.

While it might be said that the analysis that Aristotle offers of the infinite is not very far removed from the generic modern conception of the infinite, there are conceptual associations that Aristotle makes in connection with the infinite that have a much more distant ring. As Sweeney notes, Aristotle associates finitude with intelligibility, actuality and perfection, whereas he associates infinitude with unintelligibility, potentiality, imperfection, privation and wholeness. According to Aristotle—at least on Sweeney's account—an infinite line is imperfect because it lacks endpoints, and hence can be neither measured nor described. Since Aristotle takes the Prime Mover to be perfect, he does not allow that it is infinite, though he does accept that the results of the exercise of the power of the Prime Mover—the rotations of the heavenly spheres—are infinite. If one says that the Prime Mover's power is infinite then, for Aristotle, one is not really providing an 'intrinsic' description of that power, but rather saying something about what is brought about by the exercise of that power.[2]

1.3 <u>Plotinus</u>: Against Aristotle—according to Sweeney—Plotinus supposes that 'form' and 'being' are always 'determining' or 'terminating'. Given that 'matter' is 'below' 'form' and 'being', it turns out that 'matter' is 'infinite'—'imperfect' and not 'determined'. On the other hand, the 'One Itself', 'transcends' 'form' and 'being'— and all other 'forms' of 'determination'—being both 'infinite' and 'perfect'. While the 'One Itself'—the head of the neo-Platonic scale of being—is conceptually distinct from familiar monotheistic gods, it shares with them the feature that there is claimed to be a sense in which it, itself, can properly be said to be 'infinite'. Of course, one might well be given to think that this conception of 'the infinite' is only dubiously related to the key mathematical, quantitative concept that Aristotle analysed—but,

nonetheless, we clearly do have a long historical tradition of use of the label 'infinite' to describe 'that which exceeds all forms of determination'.

1.4 <u>Early Christian Thinkers</u>: According to Sweeney, Augustine, Pseudo-Dionysius, John Damascene, Gregory of Nyssa, and others from that era agreed that God is 'infinite'. By this, it seems that they mean that God is 'all-powerful', 'eternal', 'immense', 'incomprehensible' and—perhaps—'beyond being'. Philo claims that God is 'infinite' because 'incomprehensible', 'omnipotent', and 'all good'. Augustine says that that which is incorporeal is both complete and infinite: complete because whole, yet infinite because not confined by spatial location. John Damascene says that Divinity is both infinite and incomprehensible—and that this alone is comprehensible of Divinity. Once again, these uses of the term 'infinite' have very little relationship to the key mathematical quantitative concept that Aristotle analysed.

1.5 <u>Medieval Scholasticism</u>: According to Sweeney, little attention was paid to the notion of the infinite by Christian authors between the tenth century and the middle of the thirteenth century. Many theologians failed to mention the attribute at all; and those who did seem to have mentioned it only in connection with God's incomprehensibility, or eternity, or deeds, i.e. the results of the exercise of God's powers. Bonaventure, Aquinas, and other thinkers accepted Aristotle's account of quantitative infinity, and agreed that there is one world that is finite in extent. However, they also held that there is a conception of 'infinity' that applies directly to God, but that is not Neo-Platonic in its formulation. Thus, for example, while Aquinas accepts the claim that 'forms' and 'acts' are 'determinative', he also holds that 'matter' and 'potency' are 'determinative', and not merely 'negations', or 'privations', or 'mental constructs', or the like. Anything that escapes the 'determinations' imposed by 'matter' and 'potency' is properly said to be both 'infinite' and 'infinitely perfect'. While the connection between 'incorporeality' and 'infinity' harks back to Augustine—and other early Christian thinkers—the connection between 'actuality'— 'absence of potency'—and 'infinity' seems to be something new. Of course, there is a serious question about the intelligibility of the application of the description 'without potency'—but we shall not be able to pursue that question here. On the account given by Aquinas, God is properly said to be 'intrinsically' 'infinite', because 'essentially lacking in any kind of potentiality'.[3]

1.6 <u>Modernity</u>: There has been a proliferation of conceptions of divine infinity since the beginnings of early modern philosophy. Sweeney notes that some philosophers— e.g. Spinoza—suppose that God is infinite because the underlying reality of which all else is mere mode or manifestation. Sweeney also notes that other philosophers—e.g. Mill, James, and Whitehead—respond to Spinoza's contention that nothing other than God is real because nothing other than God is infinite, by insisting that God too is finite, and, in that way, allowing that there are really things other than God. Moving beyond Sweeney's account, it seems to me to be plausible to add that, in more recent times, there has been an increasing willingness, on the part of monotheistic philosophers and theologians, to suppose that at least some of the divine attributes are properly to be understood in terms of a quantitative, mathematical conception of the infinite. Thus, for example, there are philosophers—such as Swinburne (1977)—who suppose that it is quite proper to describe God's knowledge as infinite because God knows infinitely many true propositions; and who suppose that it is quite proper to describe God's power as infinite because there are infinitely many actions that God

could perform; and who suppose that it is quite proper to describe God's eternity as infinite because it endures for an infinite amount of time; and so forth. It is well known that Cantor's development of transfinite arithmetic had theological motivations (see Dauben (1990)), and that there are many subsequent philosophers and theologians who have supposed that there are respects in which God is actually mathematically infinite.

2. **How we talk**

In current English, we have the adjective 'infinite', the noun 'infinity', and the substantive 'the Infinite'. The standard use of the substantive form is 'as a designation of the Deity or the absolute Being'; and so, of course, there is one standard use of the adjectival and noun forms that rides piggyback upon this standard use of the substantive form. It seems to me that it is plausible to see the current use of the substantive 'the Infinite' as a direct descendent of Anaximander's use of the word *to apeiron* with more or less the same connotations—'imperishable', 'ultimate source of everything'—except, of course, that *to apeiron* is personalised, i.e., taken to have personal attributes and attitudes, in Christian theology.[4]

However, in current English, we also have uses of the adjective and noun forms that are not obviously related to the standard use of the substantive form. In particular, there are uses of these terms in mathematics, including geometry, and applications of these terms to space and time, in which most of the connotations associated with the substantive form seem to play no role at all. While these uses of the term do have more or less clear connections to the absence of 'limits', or 'bounds', or 'frontiers', or 'borders', they have very little to do with considerations about the absence of 'clarity' or 'distinctness', and nothing at all to do with considerations about 'the ultimate, imperishable, source of everything'.

It is not clear to me whether this separation of considerations was achieved by the Pythagoreans. Given their metaphysical belief that the positive integers are the ultimate constituents of the world, it is a plausible conjecture that they did not recognise the discussion of 'limits', or 'bounds', or 'frontiers', or 'borders'—and the application of these terms to, say, space and time—as a separate topic for investigation in its own right. But, whatever the truth about this matter may be, it seems that some of the contemporaries and immediate successors of the Pythagoreans *did* come to see the discussion of these topics as an independent subject matter. It is, I think, plausible to view Zeno's paradoxes as a contribution to such a discussion; and, even if that is not so, it is surely right—as I suggested above—to see Aristotle's treatment of infinity as an investigation of 'limits' and 'bounds'—in the context of space, time and matter—in their own right. (In *Physics*, Book III, Aristotle makes mention of Anaximander's views about 'the ultimate source of everything'. But those views are entirely incidental to the theory of 'limits' and 'bounds' that Aristotle proceeds to elaborate and defend.)

However, once it is recognised that the investigation of 'limits' and 'bounds'—in the context of space, time and matter—is a legitimate subject matter in its own right, then various questions arise about the application of the results of *that* investigation to the subject matter with which Anaximander was primarily concerned: 'the ultimate source of everything'. Even if it is true—as I think it is—that the historical

entanglement of talk about 'limits' and 'bounds' with talk about 'the ultimate source of everything' persists into the present, it is important to ask whether this entanglement has any *essential* significance for either the investigation of 'limits' and 'bounds' as a subject matter in its own right, or for the investigation of 'the ultimate source of everything' (as a subject matter in its own right). As I mentioned initially, we might well suspect that there is one conception of 'the infinite' that is appropriate to mathematics and science; and a quite different conception of 'the infinite' that is appropriate to theology—and, if that is right, we might also suspect that considerations about 'the infinite' will have little genuine interest for those who are interested in interactions between scientific and theological investigations.

3. **Science and Infinity**

Infinity is ubiquitous in classical mathematics. Classical set theory—which many suppose is foundational for classical mathematics—is committed to a mind-boggling infinite hierarchy of sets[5]; classical analysis—which is one of the fundamental tools in most applications of mathematics to science—is committed to an uncountable infinity of real numbers; classical geometries are committed to manifolds of uncountably many points; and so on.

Classical mathematics is ubiquitous in contemporary science. For example, classical analysis is a standard tool in all theoretical branches of physics and chemistry, and in all fields in which there are applications of physical and chemical theories: experimental physics, experimental chemistry, cosmology, astronomy, meteorology, geology, palaeontology, engineering, electronics, computing, communications, systems analysis, and so forth.

Should we then conclude that infinity is ubiquitous in contemporary science? Certainly not immediately. *First*, classical mathematics is not accepted universally: there are finitists, intuitionists and constructivists who oppose classical mathematics on philosophical grounds, primarily because of its commitments to the infinite. *Second*, it is not universally accepted that use of classical mathematics incurs ontological and theoretical commitments: for instance, fictionalists insist that we should treat all mathematics as useful fiction, hence not as reality-limning theory that brings with it commitment to infinite domains of entities. *Third*, it is not universally accepted that there are *ineliminable* uses of classical mathematics in practical applications of theoretical science: perhaps, for example, differential equations are useful only as approximations to difference equations, whose exact solutions would belong to merely finite mathematics. *Fourth*, even if it is granted that there are ineliminable uses of classical mathematics in practical applications of theoretical science, it is not universally accepted that there are cases in which commitment to real infinities emerge: it is not universally accepted, for example, that, just because we model space-time with classical manifolds, it immediately follows that we are committed to the infinite divisibility of space-time.

Setting the foregoing considerations aside, we can ask directly whether there are cases in contemporary science in which there is assignment of infinite values to physical quantities. Perhaps surprisingly, the answer to this question is: 'Yes!' For example, on the standard Kelvin absolute temperature scale, there are systems in which infinite temperatures are actually attained—e.g. there are states of nuclear spins of lithium

ions in lithium fluoride crystals that have temperature ±∞ on the standard Kelvin absolute temperature scale (Oppy (2006:133-6)). However, this fact does not reflect a deep feature of the physical world: it is merely a matter of convenience that we continue to use the Kelvin absolute temperature scale when we could operate with an equally acceptable temperature scale on which there are no assignments of infinite temperatures to actual physical systems.

Taking account of this kind of case, we might refine our original question: Are there cases in contemporary science in which there is assignment of ineliminable infinite values to physical quantities (i.e. assignments of infinite values to physical quantities that cannot be eliminated by reparamaterisation, renormalisation, or the like)? I think that the answer to this question is 'No!' Of course, there are cases in which very good scientific theories produce models in which there are ineliminable infinities. In the 1960s, Hawking and Penrose established that there are generic essential singularities in general relativistic space-times: there are ineliminable infinite values in standard general relativistic models of the universe (Oppy (2006:128-31)). However, the standard response to this observation amongst working cosmologists is that we know that general relativistic models of the universe are inadequate—and, in particular, that they are inadequate at precisely the places where the ineliminable infinities arise. (Why so? Because the ineliminable infinities arise where quantum considerations should dominate—and yet there is no taking account of quantum considerations in general relativistic models.)

Can we infer from the treatment of singularities in general relativistic space-times that there is no place for ineliminable infinities in contemporary science? I don't think so. While it is true that, for example, cosmologists do take the view that the presence of singularities in their cosmological models points to inadequacies in the models (rather than to the presence of genuine infinities in the world), there are other kinds of infinities about which cosmologists remain undecided and open-minded. Does the universe have an infinite spatial volume? Does the universe contain an infinite amount of mass-energy? Are there infinitely many universes? Does causal reality have an infinite past? Unless we are prepared to accept *a priori* philosophical answers to these kinds of questions, the most that we can say is that we can place lower bounds on some of the quantities that are here under discussion: we know that the universe is at least *so* big; and we know that there is at least *so much* mass-energy in the universe. And, in other cases, the best that we can say is that the questions remain controversial: some cosmologists incline towards infinitely many universes and/or an infinite causal past; some cosmologists do not.

This quick tour of science and infinity may seem disappointingly inconclusive to some. However, there are a couple of definite concluding observations that we can make. *First*, to the extent that there are genuine open scientific questions about the application of the concept of infinity to the world, those questions concern the finite measurability of features of the world. (How big? How old? How many stars? And so forth.) And, *second*, the other associations that are sometimes picked up by the word 'infinity' and its cognates have nothing at all to do with contemporary science. Science is not in the business of speculating about 'the ultimate source of everything', or the 'imperishable foundations of the perishable', or the like. Nor is it in the business of speculating about 'irrational', or 'disorderly', or 'chaotic', or 'unclear' or

'indefinite' elements of reality that lie 'beneath' or 'beyond' the physical universe that we inhabit.[6]

4. **Religion and Infinity**

Our initial examination of the etymology (and current use) of the word 'infinity' and its cognates revealed three rather different sets of connotations. First, 'infinity' is associated with the denial of ends, limits, boundaries, borders, frontiers, measures and so on: the infinite is unending, unlimited, unbounded, immeasurable, and so forth. Second, 'infinity' is—or, at any rate, has been—associated with the denial of determination, form, clarity, definition, decision, and so on: the infinite is unclear, indefinite, indeterminate, unformed, undecided, and so forth. Third 'infinity' is—at least in some places, at some times—associated with permanence, imperishability, and the ultimate source or ground or origin of everything else.

We can see reflections of all of these sets of connotations in religious talk about divinity infinity—and, indeed, in Christian talk about God's infinity. First, we may be told that the divine is temporally unending (eternal or sempiternal), unlimited in knowledge and power, unbounded in goodness and compassion, and so forth. Second, we may be told that the divine exceeds human comprehension, can only be described or thought of in terms of what it is not, and so on. Third, we may be told that the divine is permanent, imperishable, and the ultimate source, or ground, or origin of everything else.

Some may object that there is a cheat in the accounting that has just been made. On the one hand, from the standpoint of ontology and metaphysics, it may be deemed acceptable to say that the divine is temporally unending (eternal or sempiternal), unlimited in knowledge and power, unbounded in goodness and compassion, and so forth; and it may also seem acceptable to say that the divine is permanent, imperishable, and the ultimate source, or ground, or origin of everything else. But, from this ontological or metaphysical standpoint, it may well be deemed unacceptable to say that the divine is unclear, indefinite, indeterminate, unformed, undecided, and so forth. On the other hand, from the standpoint of epistemology, it may be deemed acceptable to say that the divine is unclear, indefinite, indeterminate, unformed, undecided, and so forth, provided that this is understood to be expression of the thought that the divine exceeds human comprehension, can only be described or thought of in terms of what it is not, and so on—but, in that case, there is at least *prima facie* reason to be suspicious of the claim that it is acceptable to say that the divine is temporally unending (eternal or sempiternal), unlimited in knowledge and power, unbounded in goodness and compassion, and so forth; and there may also be at least *prima facie* reason to be suspicious of the claim that it is acceptable to say that the divine is permanent, imperishable, and the ultimate source, or ground, or origin of everything else.

There is considerable diversity of opinion concerning the extent to which we can make true assertions about the attributes of divinity. Some say that we can make no true assertions about divinity. Some say that we can make no true *literal* assertions about the attributes of divinity: while we can make true assertions about divinity, those true assertions can only be metaphorical, or figural, or the like. Some say that can make no true *positive* assertions about divinity: we can only truly say what

divinity is not, but we cannot truly say what divinity is. Some say that we can make no true literal positive assertions about the attributes of divinity: we can only truly literally say what divinity is not, but we cannot truly literally say what divinity is (though we can make true positive assertions about the attributes of divinity, so long as those assertions are metaphorical, or figurative, or the like).

How we respond to the accusation, that our prior accounting of talk about 'infinity' involved cheating, depends, at least in part, upon the stance that we take on these questions about the possibility of true, positive, literal claims about divinity.

If we suppose that we can make true, literal, positive assertions about the attributes of divinity—and, in particular, if we suppose that we can truly, literally, say that the divine is temporally unending (eternal or sempiternal), unlimited in knowledge and power, unbounded in goodness and compassion, permanent, imperishable, the ultimate source, or ground, or origin of everything else, and so forth—then, I think, we ought simply to deny that the divine is unclear, indefinite, indeterminate, unformed, undecided, and so on. Moreover, if we take this line, we are free to go on to say that, in some respects, the divine is infinite in the standard, mathematical sense: perhaps, for example, the collection of propositions that is known by the divine exceeds all finite measure; and, perhaps, the range of actions that could be carried out by the divine exceeds all finite measure; and so forth.

However, if we suppose that we can *only* truly say what the divine is not, then it seems to me that, while we are then obliged to say that the divine is not clear, and not definite, and not determinate, and not formed, and not decided, and so on, we are also then obliged to say that the divine is not unending, and not unlimited in knowledge and power, and not unbounded in goodness and compassion, not permanent, not imperishable, and not the ultimate source, or ground, or origin of everything else. Moreover, if we take this line, then we can only go on to say that the divine is not finite; but we cannot insist that the divine is infinite in the standard, mathematical sense. For, to say that the divine exceeds all finite measure (in some respect or other) surely would be to say something about what the divine is, not merely what it is not.

Of course, there are many intermediate positions here—between the view that says that we can make a wide range of true, literal, positive assertions about the attributes of the divine, and the view that says that we can only truly say what the divine is not—but the important point to which I wish to draw attention is the significance of the distinction between the infinite and the non-finite for all of the positions in the range. It is one thing to say that something is non-finite—i.e. to say that something does not have a finite measure; it is quite another thing to say that something is infinite—i.e. to say that it exceeds all finite measure. Something can be non-finite because it is a kind of thing to which they concept of measure has no application; however, something can only be infinite—in the standard, mathematical sense—if it is the kind of thing to which the concept of measure has application.

We can make sense of the idea that the universe is infinite in extent because (i) we have a measure concept that applies to finite volumes, and (ii) we can then form the concept of a volume that exceeds all finite measure. Correspondingly, we can make sense of the idea that the divine is infinite—in the standard, mathematical sense—with respect to an attribute F, provided that (i) we have a measure concept that applies

to the attribute F, and (ii) we can make sense of the idea that the divine possesses the attribute F in a manner that exceeds all finite measure. So, for example, if we suppose that amount of knowledge can be measured by number of propositions known, then we can make sense of the idea that the divine has infinite knowledge by supposing that there are infinitely many propositions that are known to the divine.

Those who are inclined to look favourably on the view that we can only truly say what the divine is *not* are often also inclined to look favourably on the view that the divine and the mundane have no features in common: there are no properties that are shared by the divine and the mundane. Some who take this kind of view may go so far as to say that God does not have knowledge in the same sense that human beings do; and perhaps those people will then go on to deny that God has infinite knowledge in the sense explained in the previous paragraph. (It may be true that one human being is more knowledgeable than a second if that first knows more propositions than the second; but it is not true that God knows more than human beings because God knows more propositions than human beings do.) Of course, someone who takes this line will deny that God has finite knowledge; but that denial does not amount to an acceptance of the claim that God has infinite knowledge, on the standard mathematical account of the infinite.

I am inclined to think that it is incoherent to suppose that one can only truly say what the divine is not; and I am inclined to think that there is a range of opinion at that end of my scale that is also incoherent.[7] However, for the purposes of the present chapter, it does not matter whether these suspicions of mine are well-founded. The significant point that emerges from the preceding discussion is that there is considerable complexity involved in the proper interpretation of *literal* religious talk about divine infinity. Some literal talk about divine 'infinity' will clearly be properly interpreted as talk about divine non-finitude: the divine is not limited, not bounded, not terminating, not ending, and so forth. Some literal talk about divine 'infinity' is properly interpreted as talk about divine infinitude: the divine possesses knowledge that exceeds all finite measure; the divine possesses power that exceeds all finite measure; the divine possesses goodness that exceeds all finite measure; the divine possesses compassion that exceeds all finite measure; and so on. And some literal talk about divine 'infinity' is properly interpreted as talk that really has no direct connection to either finitude or infinitude: the divine is imperishable, unchanging, the ultimate source of everything else, and so forth.[8] Whenever we come across talk about divine 'infinity', we need to think carefully about the proper interpretation to put upon that talk.

5. Concluding Remarks

Given the preceding accounts of the role of the concept of the infinite in contemporary science, and the various ways in which talk about divine infinity can be properly interpreted, we can fairly quickly conclude that the suspicions that I aired at the beginning of this chapter are largely borne out. Over time, the standard mathematical concept of the infinite has emerged as one refinement of the notion of the non-finite. As that refinement has taken place, there has been some take up of the standard mathematical concept of the infinite in talk about the divine; but there has also been continued use of the notion of the non-finite in that talk. To the extent that talk about divine infinity is merely talk about the non-finitude of the divine—or talk

about the permanence, etc. of the divine—that talk does not even share sense with scientific conceptions of infinity (and so there is not even the possibility that conflict or cooperation between science and religion might emerge at that point). However, to the extent that talk about divine infinity is talk about the infinity of the divine (in the standard mathematical sense), such talk does at least share sense with scientific conceptions of infinity. But, even if this at least leaves open the possibility that conflict or cooperation between science and religion might emerge at this point, it seems rather implausible to suppose that considerations about infinity could be a significant locus of either conflict or cooperation between science and religion.

Bibliography

Barrow, J. *The Infinite Book*. London: Vintage, 2005

Conway, J. *On Numbers and Games*. London: Academic, 1976

Dauben, J. *Georg Cantor: His Mathematics and Philosophy of the Infinite*. Princeton: Princeton University Press, 1990.

Devlin, K. *The Joy of Sets*. Berlin: Springer-Verlag, 1991.

Gamow, G. *1, 2, 3, … Infinity* London: Macmillan, 1946.

Moore, A. W. Infinity. In E. Craig (Ed). *Routledge Encyclopaedia of Philosophy* (pp.772-8) London: Routledge, 1998.

Oppy, G. *Philosophical Perspectives on Infinity*. Cambridge: Cambridge University Press, 2006.

Oppy, G. God and Infinity: Directions for Future Research. In M. Heller and H. Woodin (Eds). *New Frontiers in Research on Infinity*. Princeton: Princeton University Press, forthcoming.

Rucker, R. *Infinity and the Mind*. Sussex: Harvester, 1982.

Sweeney, L. *Divine Infinity in Greek and Medieval Thought.* New York: Peter Lang, 1992.

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[1] Anaximander's account of his first principle is reported in Plato's *Philebus* (16C, 23C), and Aristotle's *Metaphysics* (987a15-19).

[2] One might well wonder whether it is really possible to make sense of the distinction between 'intrinsic' and 'extrinsic' characterisations of powers. However, I shall not attempt to explore this question here.

[3] According to Sweeney (1992), no one prior to Richard Fishacre gives any evidence of having supposed that a monotheistic god could be 'intrinsically' infinite—i.e., roughly, not merely infinite in its relations to other entities, but infinite 'in itself'. Moreover, according to Sweeney (1992), it is not until Aquinas observes that 'matter or potency determines form'—because 'matter or potency limits the perfection of form'—no less than 'form determines matter or potency'—because 'form confers perfection on matter or potency'—that any philosopher or theologian arrives at a clear understanding of how it can be that a monotheistic god is 'intrinsically' infinite. For Aquinas—according to Sweeney (1992)—it is *because* a monotheistic god has no matter or potency that it can properly be said to be 'intrinsically infinite': it is not 'limited' or 'determined' by 'matter or potency'. I think that one might well doubt whether the categories to which Sweeney here appeals—'matter', 'form', 'potency', 'act', 'determination', 'limit'—are suitable to the kind of fundamental inquiry that metaphysicians pursue; however, I won't try to argue for this suspicion here.

[4] Of course, most, if not all, Christian theology *repudiates* other connotations that many of Anaximander's contemporaries associated with the term: 'chaotic', 'irrational', 'disorderly', and so forth. I think that there are the raw materials for an interesting investigation in the history of ideas here. The early philosophers were, I think, mostly disposed to view 'ultimate' reality as a mixture of 'good' and 'evil' (or 'chaos' and 'order', or the like). An advantage of this view is that it seems to comport well with observation: the world is mixed, so it is natural to suppose that 'ultimate' reality is also mixed. On the other hand, Christianity teaches that 'ultimate' reality is unalloyed 'good' (or 'order', or the like). An advantage of this view is that it seems to comport well with what we would like: it would

be better if 'ultimate' reality were not mixed. I think that it would be very interesting to trace out the history of ideas here, to try to establish how and why the Christian view came to be widely accepted.

[5] See, for example, Devlin (1990) and Rucker (1982). And, for an introduction to an alternative way of thinking about the foundations of the theory of numbers, see Conway (1976).

[6] For further discussion of the role of infinity in science, see, for example, Barrow (2005) and Gamow (1946).

[7] For some arguments in support of the position that I announce here, see Oppy (forthcoming).

[8] Of course, there are similar points to make about non-literal—metaphorical, figurative—talk about divine 'infinity'; but we don't have time and space to set out the details here.