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ORIGINAL ARTICLE

Underdetermination and unconceived alternatives in science and theology: some historical perspectives

Peter Harrison

University of Notre Dame, Centre for the History of Philosophy, Sydney, NSW, Australia
Email: peter.harrison@uq.edu.au

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Abstract

P. Kyle Stanford's *Exceeding our Grasp* (2006) shows how the problem of unconceived alternatives presents a significant challenge to realism. Stanford argues that the history of science offers repeated instances of scientists failing to conceptualize rational alternatives to ruling scientific doctrines, implying that our present scientific theories are likely to be similarly underdetermined. This article extends Stanford's argument and provides it with a longer history. It shows how the principle of unconceived alternatives was explicitly deployed during the medieval and early modern periods to undermine scientific realism in particular cases. These arguments typically made reference to divine omnipotence and the principle that God could have produced phenomena in numerous ways inconceivable to finite human minds. In this theological register, unconceived alternatives offered a way of minimizing potential tensions between theological doctrines and prevailing scientific theories. The article concludes with some brief reflections on the applicability of the principle of unconceived alternatives to conceptions of God.

Keywords: underdetermination; Pierre Duhem; scientific realism; instrumentalism

P. Kyle Stanford's *Exceeding our Grasp* (Stanford 2006) poses a serious challenge to scientific realism by setting out a novel argument, in the context of contemporary discussions at least, for the underdetermination of scientific theories. The general problem of underdetermination is well-known and relatively straightforward: on occasion, there will be insufficient evidence to choose between competing scientific theories that are more or less empirically equivalent. Stanford proposes that the problem can be extended, in principle, to every theory in the fundamental theoretical sciences, since, or so he argues, for every presently successful scientific theory there may be alternatives that we simply have not thought of. Stanford argues that this argument is supported by the history of science which offers numerous examples of successful theories in the past that were subsequently replaced by alternative theories that proponents of the old theory had not conceived of but, in principle, could have, given that subsequent thinkers did so. Hence the problem of 'unconceived alternatives'.

I am in basic agreement with Stanford's formulation of the issues and the problem that this generates for versions of scientific realism. In this article I will offer some additional historical context for Stanford's arguments and perhaps what amounts to further historical justification for it. I am particularly interested in historical precedents for precisely the kind of argument that Stanford offers, but which in their original contexts were informed by theological considerations. My suggestion will be that we already encounter the problem of unconceived alternatives in the medieval period in the context of arguments relating to the limitations of natural philosophy and specifically to some Aristotelian doctrines. Two theological claims are relevant – the omniscience of God, especially considered in relation to human knowledge claims; and the fallen (or otherwise limited) condition of human minds. A passage in Stanford's *Exceeding our Grasp* immediately struck me, on reading it, as directly pertinent to these earlier theological discussions:

> We might instead think of ourselves as marshalling evidence from the historical record for a quite general claim about *human beings as cognitive agents*: that we are not good at conceptually exhausting spaces of serious alternative possibilities ...
>
> While it seems possible to imagine *cognitive supercreatures* who are adept at conceiving of all possible theoretical explanations for a given set of phenomena ... the evidence suggests that we are simply not cognitive creatures of this kind. (Stanford 2006, 45, emphasis added)

The question of our status as cognitive agents falls within the ambit of theological anthropology and during the early modern period this was an area of lively debate. A key issue was the extent of cognitive damage wrought upon human minds by the fall, and how various estimates of that damage informed the methods of the new experimental natural philosophy. As for Stanford's imaginary 'cognitive supercreatures', medieval and early modern philosophers did not have to imagine such beings. There was a universal consensus that such a supercreature existed in the person of an omniscient and omnipotent God, a being whose knowledge and power was commonly used to establish the underdetermination of humanly conceived scientific theories. In what follows, I will expand on these two theological principles, beginning first with divine omniscience before moving to a discussion of human cognitive limitations.

Divine omniscience and unconceived alternatives

One of the well-known difficulties confronting medieval observers of the heavens was a dual legacy deriving from the discrete disciplines of natural philosophy (or physics) and astronomy that seemed impossible to unify. On the one hand, Aristotle had provided a *physics* that offered a causal, theoretical account of the motions of the heavenly bodies. On the other, Ptolemy had provided an elegant *astronomical model* that accounted for what we actually observe. The Aristotelian theory was not always consistent with how things appear to us. His assumption, for example, that the earth was at the centre of concentric planetary spheres could not account for observed variations in planetary distances from the earth. Ptolemy had proposed eccentric planetary orbs to account for this, but his overall mathematical model, while it offered reliable predictability, did not provide a causal scientific explanation of the heavenly motions, at least in terms of how scientific explanation was then understood.

The Jewish philosopher Moses Maimonides (1138–1204) explained the predicament as follows:

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> Consider, therefore, how many difficulties arise if we accept the theory that Aristotle expounds in Physics. For according to that theory there are no epicycles and no excentric spheres, but all spheres rotate around the centre of the earth! ...
>
> These difficulties do not concern the astronomer; for he does not profess to tell us the existing properties of spheres, but to suggest ... a theory in which the motion of the stars is circular and uniform *and yet in agreement with our observation*. (Maimonides 2004, 332–333)

Maimonides concludes that the hypotheses of astronomy, set out in Ptolemy's *Almagest*, are 'totally contrary to the results of Natural Science' (which is to say, contrary to Aristotelian physics) (Maimonides 2004, 333). This inconsistency, Maimonides goes on to suggest, is owing to the inherent limitations of the human intellect along with the remote and perfect nature of the heavens. That notwithstanding, there is a true science of the heavens which resides in the mind of God:

> But of the things of the heavens man knows nothing except a few mathematical calculations, and you see how far these go ...
>
> God alone has a true and perfect knowledge of the heavens, their nature, the essence, their form, their motions and their causes ... For the facts which we require in proving the existence of heavenly beings are withheld from us: the heavens are too far from us and too exalted in place and rank. Man's faculties are too deficient to comprehend. (Maimonides 2004, 333)

By 'true science', in this context, Maimonides most likely had in mind Aristotle's understanding of genuine *scientia*, which is knowledge that we arrive at through a process of logical demonstration from secure premises (Aristotle, *Posterior Analytics* 78a22–79a33). Maimonides concluded that the human mind could only ever arrive at such a science of the heavens if God directly communicated it to us, for example, in the manner in which he had once spoken 'face-to-face' with Moses. In sum, there was a solution to the contradiction between Aristotelian physics and Ptolemaic astronomy that humans were in principle unable to conceive of, and which resided only in the mind of God.

The imperfection of human knowledge in relation to divine knowledge, and the possibility of unconceived arguments was also relevant to medieval discussions of the status of theological knowledge. Writing on the subject of the Trinity, Richard of St Victor (d. 1173), for example, proposed that there were arguments based on necessity for the truths of the faith, 'even if our efforts have not yet uncovered them' (Richard of St Victor, *On the Trinity* 1.4). This concession is not unrelated to Thomas Aquinas's (d. 1274) subsequent discussion of the scientific status of Christian theology, with 'science' being again understood in the Aristotelian sense of knowledge capable of demonstration from secure premises. On the face of it, theology could not claim scientific status, because its basic premises were not self-evident, or at least not to us. Aquinas ingeniously argued that its premises were self-evident to God, however, and hence theology was a science for God himself. For human subjects, however, it could only be a 'subordinate science' – a science that derived its principles secondarily from the higher science of God's self-knowledge. A subordinate science was understood to be a science that derived its first principles from a higher science (Aristotle, *Posterior Analytics*, 1.9; Distelzweig 2013). We have access to the self-evident principles of

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theology to the extent that God reveals them to us (Aquinas, *Summa theologiae*, 1a. 1, 2; Turner 1997).

The principle is similar to that outlined by Maimonides in relation to a putative science of astronomy. God knows how the heavens operate and, theoretically, could communicate that knowledge to human minds. Only in that instance could we be confident that we had a scientific grasp of the motions of heavenly bodies. As for astronomy, Aquinas endorsed the common view that our knowledge of heavenly motions was inevitably underdetermined because while we might be able to offer accurate predictions in the realm of astronomy – 'save the appearances' is the classic expression for this – there could always be other ways of accounting for the motions of the heavenly bodies that we had simply not thought of: 'For although these suppositions [of Eudoxus and later astronomers] might save the appearances [*apparentia salvarentur*], yet it is not necessary to say that they are true, because perhaps the appearances regarding the motion of the stars might be saved in some other way not yet understood by men' (Aquinas, *De caelo et mundo* 2.17.2). This instrumentalist understanding of mathematical astronomy would later play a major role in controversies about the status of the Copernican hypothesis.

Before turning to these debates in early modern astronomy it is worth considering one other occasion when divine omnipotence and omniscience – our theological equivalent of 'a cognitive supercreature' – were invoked in assessments of the validity of particular scientific claims. The second half of the thirteenth century witnessed a growing influence of Aristotelian philosophy in the Arts faculties of the medieval universities. Aquinas's invocation of Aristotle's understanding of the sciences is just one measure of this influence. The ascendency of Aristotelian thought gave rise to concerns that the authority of the Greek philosopher might be elevated over more traditional religious sources of authority. Already, there had been lively debates over Aristotle's teaching of the eternity of the universe, which was clearly contrary to biblical teachings. This provided part of the context for Maimonides' discussions of the status of astronomy. There were sporadic attempts throughout the thirteenth century to censure certain Aristotelian doctrines, but things came to a head in the year 1277, when the Bishop of Paris, Stephen Tempier, promulgated a list of 219 propositions that it would now be forbidden to teach at the University of Paris.

The list is a heterogeneous one, but many of the items related to the philosophy of Aristotle. For our purposes what is significant about the prohibitions is the manner in which divine omnipotence, and the possibility space that it represented, was used to refute aspects of Aristotelian science. The propositions below (which set out views that are being condemned) offer some sense of this:

> 17. That what is impossible absolutely speaking cannot be brought about by God or by another agent. – This is erroneous if we mean what is impossible according to nature.
>
> 23. That God cannot move anything irregularly, that is, in a manner other than that in which He does, because there is no diversity of will in Him.
>
> 66. That God could not move the heaven in a straight line, the reason being that He would then leave a vacuum. (Fortin and O'Neill 1963, 340, 343)

There are a few relevant considerations here. First, consistent with a number of other propositions, is a broad challenge to the authority of Aristotle. Second, and more specifically, we see an insistence that what might be impossible according to Aristotelian philosophy is not necessarily impossible for God. Third, is the suggestion that our difficulty in

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envisaging some state of affairs – such as the existence of vacuum – should constitute no barrier to theoretically entertaining its possibility. This is on account of the power of God to produce natural effects in ways that we cannot imagine. More broadly, divine omnipotence – understood as God's power to doing anything that is logically possible – was ranged against the limits of current scientific understanding.

On the face of it, a conservative theological reaction against the best prevailing science of the time, that of Aristotle, seems illustrative of the once fashionable myth of a perennial historical warfare between science and religion. Be that as it may, whatever the intentions of Tempier, this event turned out to be a significant milestone in the emergence of modern science. The ultimate effect of these condemnations was to liberate philosophers from slavish adherence to Aristotelian dogmas. Crucially, moreover, it introduced counterfactual thinking, based on notions of divine omnipotence, into scientific reasoning. It was on this basis that physicist, historian, and philosopher Pierre Duhem (1861–1916) contended that the birth of modern science could be dated to the year 1277 (Duhem 1909, vol. 2, 412, vol. 3, 227). This assessment is now generally regarded as an exaggeration, but most historians of science concede that a renewed emphasis on the possibilities represented by divine omnipotence, and a trend in the direction of theological voluntarism, were important precursors to the experimental natural philosophy in the early modern period (Grant 1979; Funkenstein 1986; cf. Carroll 2022).

What we can say with some certainty is that all the considerations outlined above played an important role in the Galileo affair, in which the status of the Copernican hypothesis – whether it was to be understood traditionally as a means of saving the phenomena, or whether it might be considered as something more – was a central issue. The notorious preface that Andreas Osiander added to Copernicus's *De revolutionibus*, which outlines his heliocentric model, provides the context:

> it is not necessary that these hypotheses should be true, or even probable; but it is enough if they provide a calculus that fits the observations
>
> But since for one and the same movement varying hypotheses are proposed from time to time ... the astronomer much prefers to take the one which is easiest to grasp. Maybe the philosopher demands probability instead; but neither of them will grasp anything certain or hand it on unless it has been divinely revealed to him. (Copernicus 1995, 4)

While Osiander's insertion was not authorized by Copernicus and was perhaps at odds with the author's more realist ambitions, there was nothing particularly controversial about the instrumentalist status accorded by Osiander to the Copernican hypothesis. He simply points out that our theories about heavenly motions will inevitably be underdetermined – that 'varying hypotheses are proposed from time to time'. Given this situation, resort must be had to other criteria for choosing between empirically equivalent alternatives. Astronomers opt for simplicity; philosophers consider the probability of various physical possibilities. Osiander thus drew the customary distinction between astronomical (instrumentalist) and natural philosophical (causal) explanations. He also appealed to the gold standard of revealed knowledge, based on God's omniscience, as offering the only genuine prospect of certainty in the case of our knowledge of the heavens.

Galileo's subsequent defence of the Copernican hypothesis, in realist terms, first came to the attention of the Inquisition in the second decade of the seventeenth century. In 1615, he was counselled by Cardinal Bellarmine to treat Copernicanism as a hypothetical device for saving the appearances. This was because heliocentrism was inconsistent with both the current scientific consensus and scripture. (The heliocentric model was beset with a number of scientific difficulties, not least that its predictions relating to stellar parallax and the Coriolis effect were not confirmed by observations at the time. The alternative Tyconic model was a better fit for the current observations (Graney 2015).) Galileo's intransigence generated a more strict formal censure in 1616, which enjoined him to abstain completely from teaching or defending heliocentrism and the motion of the earth, at least until such time as there were acceptable proofs.

Following the 1623 elevation to the papacy of his friend and patron Maffeo Barberini (Pope Urban VIII), Galileo was emboldened to revisit the heliocentric theory, eventually publishing in 1632 his *Dialogue Concerning the Two Chief World Systems*. He had mistakenly thought the dialogue form of the work would shield him from the unwanted attentions of the Inquisition. He also relied upon the good offices of Urban VIII, who knew of the book and requested that Galileo represent his own views in it. Galileo obliged, but imprudently placed the pope's argument in the mouth of Simplicio, a conservative character of modest intellectual ability. Unsurprisingly, this precipitated the subsequent and well-known actions of the Inquisition, who censured Galileo in 1633. Of particular significance are the words of Simplicio, that we may take to represent the position of Urban VIII and the Catholic magisterium:

> *Simplicio*: I know that if asked whether God in His infinite power and wisdom could have conferred upon the watery element its observed reciprocating motion using some other means than moving its containing vessels, both of you would reply that He could have, and that *He would have known how to do this in many ways which are unthinkable to our minds.* From this I forthwith conclude that, this being so, it would be excessive boldness for anyone to limit and restrict the Divine power and wisdom to some particular fancy of his own. (Galileo Galilei 2001, 538, my emphasis)

The specific argument referred to here concerns the tides, which Galileo (mistakenly) thought clinched his case for the motion of the earth. But the principle applies more broadly. While to modern readers Simplicio's point may seem overly pious and pedantic, as we have seen, it represented the orthodox position of the period concerning astronomical phenomena: first, that God can produce natural effects in ways that are presently unknown; second, that there are many ways, some literally inconceivable, in which observed phenomena might be produced. We can add that in any case, the appeal to underdetermination was not merely theoretical, given the existence of the competing Tychonic model which Galileo disingenuously chose to ignore. Given all this, claiming to possess the sole true theory of the heavenly motions seemed arrogant and presumptuous.

Moving to the next phase of the story, it is often assumed that Newton provided the physics that finally vindicated Galileo's observations and provided a firm basis for offering a realist account of the motions of the heavens. The very title of his magnum opus, *The Mathematical Principles of Natural Philosophy*, might also be seen as bridging the gap between a realist physics/natural philosophy) and an instrumentalist, mathematical astronomy.[1] Certainly, few now doubt that the earth is, in reality, in motion around the sun. But arguably the physics that underlies this explanation remains at the level of the instrumental. Newton himself seems to have been instrumentalist in this particular case, conceding in the *Principia* that 'I have explained the phaenomena of the heavens and of our sea, by the force of gravity, but I have not yet assigned a cause to gravity' (Newton 1999, 943). In this respect he contrasted his position with that of Descartes whose hypothesis of vortices aimed at providing a physical explanation for the orbits of the planets. For Newton, by way of contrast,

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'it is enough that gravity really exists and acts according to the laws that we have set forth and suffices for all the motions [*motus omnes sufficiat*] of the celestial bodies, and of our sea' (Newton 1999, 943, translation amended). Newton's law of gravitation might be considered another instance, in a long tradition, of saving the phenomena.

Pierre Duhem, whose name is now most closely associated with the principle of underdetermination, drew significant inspiration from these episodes in the history of science and drew some broader generalizations about scientific progress. For Duhem, our grasp of the truth will always have the capacity for indefinite improvement: 'no matter how numerous and exact the confirmations by experience, they can never transform a hypothesis into certain truth, for this would require, in addition, demonstration of the proposition that these same experiential facts would flagrantly contradict any other hypotheses that might be conceived' (Duhem 1969, 111, see also 57–58). Applying the principle to the Copernican revolution:

> To prove that an astronomical hypothesis conforms to the nature of things, it is necessary to prove not only that the hypothesis is sufficient to save the phenomena, but also that these same phenomena could not be saved if the hypothesis were abandoned or modified. … If the hypotheses of Copernicus succeed in saving all the known appearances, the conclusion will be that these hypotheses may be true, not that they are certainly true. To make the latter conclusion valid it would be necessary first to prove that no other combination of hypotheses could be devised which permitted the appearances to be saved equally well; and this demonstration has never been given. (Duhem 2018, 33, n. 111)

In keeping with this sentiment, and contrary to the tenour of most modern readings of the Galileo affair, Duhem expressed a clear preference for 'the wisdom of Bellarmine' over the 'impertinent realism' of Galileo (Duhem 1969, 107, 113). Duhem, in sum, provides the connection between modern articulations of underdetermination and those historical instances that invoke the notion of unconceived (or perhaps unconceivable) alternatives.

Limits to human cognition

Having considered some of the ways in which, for medieval and early modern thinkers, God exemplifies Stanford's 'cognitive supercreature,' I want to turn briefly to his companion claim about the capacities of 'human beings as cognitive agents'. Here the issue is why we might think that human beings have the capacity to intuit the true causes of natural events or, to express it in the terms we have been considering, to conceive of all possible alternative explanations and know which is true. Aristotle's account of scientific knowledge would offer some grounds for optimism. All humans, Aristotle declared in the opening lines of the *Metaphysics*, 'by nature desire to know' (Aristotle, *Metaphysics* 980a.). Since, to invoke another Aristotelian maxim, 'nature does nothing in vain', he thought it not unreasonable to assume that the cognitive faculties provided to us by nature will generally be reliable when it comes to knowledge of the natural world. In other words, human beings are naturally attuned to how the world is. To be sure, we might think of Aristotle's account of *scientia* as an ideal that we often fall short of.[2] But certitude was at least theoretically possible (Aristotle, *Metaphysics* 993a–b).

Christian thinkers, however, had powerful reasons to think that while a capacity for scientific certainty might have been characteristic of human beings as created in their original state of perfection, this was no longer true after the primeval fall into sin. Adam's original act of disobedience was thought to have wrought significant damage on his body and mind,

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and this included both moral *and cognitive* powers. The extent of that damage was a matter of debate, and had significant consequences for how one might view the prospect of a veridical science. This is not the occasion for a full account of that debate, but it is possible to provide a general outline.[3]

A number of scholastic thinkers took a relatively sanguine view of the cognitive damage wrought by the fall. Aquinas, for example, was sympathetic to Aristotle's anthropology, agreeing that human beings were rational animals and that accordingly the fall could not have completely extinguished reason without depriving them of their essential humanity. This meant that truths about the natural world discovered by reason and the senses – Aristotle's science was one example – could be taken as generally reliable (Aquinas *Summa theologiae* 1a. 12, 1; 1a2ae 3, 6; 1a2ae. 91; 2a2ae. 90, 3; *Sententia super Metaphysicam* I.i.3–4). Protestant thinkers of the sixteenth and seventeenth centuries were unconvinced. Martin Luther stated bluntly that 'it is impossible that nature could be understood by human reason after the fall of Adam, in consequence of which it was perverted' (Luther 2000, vol. 1, 329). Fellow reformer John Calvin agreed, pointing out that 'the corruption of our nature was unknown to the philosophers who, in other respects were sufficiently, and more than sufficiently, acute'. Had philosophers such as Aristotle been cognizant of the fall they would have been aware of its epistemological implications: 'For all who are not utterly blind perceive that no part of us is sound; that the mind is smitten with blindness, and infected with innumerable errors' (Calvin 1984, vol. 1, 154). It was common in the early modern period to argue that Adam had a direct knowledge of the essences of things and could even predict future contingents. These encyclopaedic capacities were lost to the human race as a consequence of the fall (Harrison 2007, 1–16).

The fall narrative, interpreted in a particular way, thus licensed a rejection of Aristotle's optimistic epistemology and his epistemic ideals, and provided the foundations for a new experimental, natural philosophy. This approach rejected generalizations based on common-sense observations and stressed the need for corporate investigations, conducted over long periods of time, involving intrusive investigations of nature, and yielding only probabilities rather than certainty. As Robert Hooke, one of the pioneers of experimental science, expressed it, 'every man, both from a deriv'd corruption, innate and born with him, and from his breeding and converse with men, is very subject to slip into all sorts of errors'. Given this, knowledge acquisition could not be business as usual, as Aristotle had thought, but a recovery exercise that offered a partial restoration of our Adamic capacities: 'The only way which now remains for us to recover some degree of those former perfections, seems to be by rectifying the operations of the Sense, the Memory, and Reason'. The means of accomplishing this was the new experimental science: 'These being the dangers in the process of humane reason, the remedies of them all can only proceed from the real, the mechanical, the experimental philosophy' (Hook 1665, unpaginated preface).

These sentiments were common among advocates of the new, experimental science and played a key role in its justification. The current status of natural science, and its remarkable successes, has tended to obscure the fact that for its seventeenth-century originators it was a modest enterprise that fell well short of the Aristotelian scientific ideals. As John Locke expressed it: 'Works of Nature are contrived by a Wisdom, and operate by ways too far surpassing our Faculties to discover, or Capacities to conceive, for us ever to be able to reduce them into a Science' (Locke 1989, 224). Experimental philosophy might be an improvement on Aristotelianism. Indeed, it might be the best that we can do. But it will never amount to genuine science. At best, it is a stab in the dark (Locke 1975, 645; see also 444, 560).

The modesty of the goals of the progenitors of modern science, prompted by theological considerations relating to both divine omniscience and human cognitive limitations, is consistent with a cautious empiricism or instrumentalism. On this analysis, modern-day

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scientific realists are heirs to two opposing traditions – on the one hand, an optimistic Aristotelian ideal, based on his teleological assumptions about what is possible for us to know; on the other, an experimentalism based on rather different, theological anthropology that implies the impossibility of attaining Aristotelian ideals. While few now subscribe to the ideas of a fall from grace that supported the development of experimental natural philosophy, it is not clear that, say, an alternative evolutionary account would inspire any greater confidence in our capacity to envisage all the explanatory alternatives for natural phenomena.

Theology as an underdetermined science?

I hope to have shown that Stanford's suggestions about unconceived alternatives derive considerable support from the history of science, and not only in the way he suggests – that is, not simply as a repository of instances of well-established theories being replaced by better ones that no-one at the time had thought of. We are now in a position to see that past figures were equally aware of the problem of unconceived alternatives, albeit typically expressed in theological terms: not 'cognitive supercreatures' but an omniscient Deity; not just conceptually limited human minds, but creatures limited on account of a fall from an original perfection. Pierre Duhem provides an important link between past and present. Whereas we tend to think of him as the original articulator of the problem of underdetermination, he is perhaps better thought of as reviving a long-standing medieval and early modern stance. That we have forgotten about these past advocacies of underdetermination is partly to be attributed to the success of the modern sciences and the natural but mistaken assumption that this confers a degree of reality upon the theoretical entities that they posit. Our amnesia is also very likely due to the loss of plausibility of the broader theological context in which the arguments were originally articulated. As Stanford shows, however, they can be re-formulated in non-theological terms.

By way of conclusion, I also want to reflect on the broader theme of this special issue, which is devoted to unconceived conceptions of God, rather than the natural world. The question is whether, if we assume there is some force to the argument from unconceived alternatives as it applies to science, the same might be true for theology too. The historical examples above might be informative because they suggest one reason for thinking that there is a significant difference in the respective cases. The standard contrast was between a divine mind in which was lodged knowledge of the true state of affairs, and human minds which might conceive of options, but without any certainty as to which might be correct or even if the correct option was conceivable at all. The only prospect for certainty, under these conditions, was if God chose to directly reveal the truth to human minds. Hence, Maimonides suggests that only a direct divine communication would guarantee the certainty of any astronomical claim, while Osiander proposes similarly that neither philosophers nor astronomers will possess any certain knowledge unless God reveals it to them. Most likely Maimonides and Osiander are not suggesting this as a genuine possibility but appealing to this principle in order to establish the provisional status of all natural knowledge. In effect, anyone laying a claim to scientific certainty is proposing that they have some privileged access to special revelation.

Divine revelation has seldom been regarded as a normal source of knowledge about the natural world (although there are exceptions, Fanger 2012, 4; Harrison 2024, 179, n. 180). But revelation *is* foundational to theology. For the Western religious traditions, while we may discover limited things about God from reason and nature, the fundamental source of our knowledge of God is divine revelation. Recall Thomas Aquinas's discussion of the scientific status of theology and his proposal that theology is a different kind of science to natural philosophy. Theology's status as a subordinate science depends on the fact that

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God reveals his self-knowledge to us. Restating this in participatory terms, our knowledge arises out of participation in divine self-knowledge. This move, in theory at least, obviates difficulties that the problem of unconceived alternatives might represent, since in this case the relevant knowledge comes directly from a 'cognitive supercreature'. Admittedly, the notion of revelation is itself internal to specific religious traditions and may well be the kind of principle that could be re-imagined under the rubric of unconceived alternatives. And, of course, while in principle revelation might serve as a source of impeccable knowledge, there remains the question of how to determine the legitimacy of any putative revelation, especially when faced with competing confessional claims (Locke 1975, 667). Stanford's suggestion of unconceived alternatives is nonetheless relevant here, because it may offer a way of easing confessional conflicts based on apparently irreconcilable theological positions. (Think here of the problem of squaring human free-will and divine omnimpotence, which informs Augustinian *versus* Pelagian positions, or Calvinism *versus* Arminianism.) Perhaps in these instances there are theological solutions that have not yet been thought of.

One final aspect of medieval discussions of the scientific status of theology is relevant to these discussions. Aquinas asks not only whether theology is a science but, following Aristotle's division of the sciences, whether it is a theoretical or practical science. Is theology a science concerning with knowing, or doing? Aquinas hedges his bets, proposing that to a degree it is both – it involves seeking to know God, but also seeking to orient our lives to the good. Yet the primary emphasis for Aquinas is on the theoretical aspect, which is to say knowing God (Aquinas, *Summa theologiae* 1a. 1, 4). Aquinas's contemporary Bonaventure explored the same question also conceding that theology involved both speculative and practical elements. But his emphasis was on the practical: the overall end of theology is that we become good and come to love God (Bonaventure, *Proemium in I Sent*., q. 3). In the latter case, alighting on the correct *concept* of God is not the ultimate goal of theology at all. This points us to a rather different and perhaps prior question to that under consideration: not our concept of God, but our *concept of theology* which determines the relative importance of holding to a correct intellectual conception of God. How we answer that question will determine whether concepts of God are the chief concern of theology, as opposed to more practical concerns of the pursuit of the good life. Of course, if Aquinas and Bonaventure are both right – and Plato, too, for that matter – these may not, in the end, be opposing goals.

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Notes

1. On the significance of Newton's title in relation to the once distinct disciplines of natural philosophy and mathematics, see Cunningham (1991).
2. For Aristotle's account of *scientia* as primarily aspirational see Pasnau (2017), 4–6.
3. For a more complete account see Harrison (2002) and Harrison (2007).

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