God and Nature in the Thought of Robert Boyle

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THERE IS WIDESPREAD AGREEMENT among historians that the writings of Robert Boyle (1627–1691) constitute a valuable archive for understanding the concerns of seventeenth-century British natural philosophers. His writings have often been seen as representing, in one fashion or another, all of the leading intellectual currents of his day.[1] There is somewhat less consensus, however, on the proper historiographic method for interpreting these writings, as well as on the specific details of the beliefs expressed in them. Studies seeking to explicate Boyle's thought have been, roughly speaking, of two general sorts. On the one hand there are those studies of a broadly "intellectualist" orientation which situate his natural philosophy within the intellectual context provided by metaphysics, religion, and early modern science. In this connection his corpuscularianism has been shown to be motivated by specific epistemological, theological, as well as empirical concerns. One of the central aims of such studies has been to show that apparently discordant elements in his scientific thought are rendered coherent by referring them to such "non-scientific" commitments. Among studies of this sort might be mentioned the works of John Hedley Brooke, E. A. Burtt, Gary B. Deason, J. E. McGuire, R. Hooykaas, Robert H. Kargon, Eugene M. Klaaren, P. M. Rattansi, and Richard S. Westfall.[2]

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[1] See, for example, E. Klaaren, *The Religious Origins of Modern Science* (Grand Rapids, Mich.: Eerdmann's, 1977) 129; E. A. Burtt, *The Metaphysical Foundations of Modern Science*, rev. ed. (New York: Doubleday, 1954), 167.

[2] John Hedley Brook, "Newton and the Mechanical Universe," in *Towards a Mechanistic Philosophy* (Milton Keynes: The Open University, 1974), 74–77; E. A. Burtt, 187–96; R. Hooykaas, *Religion and the Rise of Modern Science* (Edinburgh: Scottish Academic Press, 1972), 17–19; Robert H. Kargon, *Atomism in England from Hariot to Newton* (Oxford, 1966); E. M. Klaaren, 164–76; J. E. McGuire, "Boyle's Conception of Nature," *Journal of the History of Ideas* 33, no. 4 (Oct–Dec 1972); P. M. Rattansi, "Paracelsus and the Puritan Revolution," *Ambix*, xi (1963): 24–32;

Other studies adopt what may be called a "social contextualist" approach. These studies emphasize the wider cultural context in which Boyle wrote, and explain particular metaphysical, theological, and scientific features of his writings by reference to the social, political, and economic motives he can be supposed to have embraced. In this genre must be mentioned broader studies of seventeenth-century England by James Jacob, Margaret Jacob, Simon Schaffer, Steven Shapin, and Charles Webster.[3] A sense of the kind of conclusions scholars have reached using this approach can be conveyed by considering the following explanation of Boyle's view of the relationship between God and nature. According to James and Margaret Jacob: "[Conservative reformers like Boyle] developed a metaphysics of God and matter that authorized a conservative interpretation of the social hierarchy and answered the radicals by rendering their social views untrue in terms of the conservative metaphysics. In other words, a conservative matter theory was constructed which 'outlawed' radicalism from the universe."[4] According to Shapin:

> To the social groups for whom Boyle spoke the radical sectarian threat had to be opposed, and one way of opposing it was to produce and disseminate a philosophy of nature and God which insisted that material entities were 'brute and stupid', that God was not immanent in nature, and that, therefore, nature, like a congregation and civil society generally, required for its activity the superintendence of external ordering and animating agencies. . . . The natural philosophy of Boyle and the early Royal Society was generated with a view to these social and moral uses; it was evaluated partly on the basis of how well it could be used in those contexts.[5]

On this approach Boyle's view of the relationship between God and nature is understood as derivative from social and political motives arising from an

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"The Intellectual Origins of the Royal Society," *Notes and Records of the Royal Society of London* 23 (Dec. 1968): 129–43; Richard S. Westfall, *Science and Religion in Seventeenth Century England* (Binghamton, N.Y.: Yale University Press, 1958), 83–92.

[3] James Jacob, "The Ideological Origins of Robert Boyle's Natural Philosophy," *Journal of European Studies* 2 (1972): 1–21; *Robert Boyle and the English Revolution* (New York: Burt Franklin and Co., 1977); "Boyle's Atomism and the Restoration Assault on Pagan Naturalism," *Social Studies of Science* 8 (1978): 211–33; Margaret Jacob, *The Newtonians and the English Revolution 1689–1720* (Ithaca, N.Y.: Cornell University Press, 1976). J. R. and M. Jacob, "The Anglican Origins of Modern Science: The Metaphysical Foundations of the Whig Constitution," *Isis* 71 (1980): 251–67; Simon Schaffer, "Natural Philosophy," in G. S. Rousseau and R. Porter, eds., *The Ferment of Knowledge* (Cambridge: Cambridge University Press, 1980), 55–91; Steven Shapin, "Social Uses of Science," in G. S. Rousseau and R. Porter, eds., 93–139; "History of Science and its Sociological Reconstructions," *History of Science* 20 (1982): 157–211; Charles Webster, "Puritanism, Separatism, and Science," in David C. Lindberg and Ronald L. Numbers, eds., *God and Nature* (Berkeley: University of California Press, 1986), 192–217; *The Great Instauration: Science, Medicine and Reform 1626–1660* (London: Duckworth, 1975).

[4] James and Margaret Jacob (1980), 253–54.

[5] Steven Shapin (1982), 182.

interest in maintaining the status quo by keeping the masses in check. Considerations arising from intellectual concerns, such as coherence with theological doctrines, philosophical acceptability, and scientific fertility, are themselves in need of further, more fundamental explanation in terms of the socio-political factors obtaining in Restoration England.[6]

Each of these approaches has contributed considerably to our appreciation of the complex factors involved in the development and expression of Boyle's thought. Despite this significant progress, however, there remain aspects of his writings on God and nature which have been relatively neglected. Social contextualist studies have provided us with valuable insight into the wider cultural milieu in which he wrote and the effect this may have had on the expression of some of his views. But they have contributed little of value to the clarification of the properly philosophical sources of his view, because they do not directly address the issue of understanding the logical and metaphysical considerations which impose restrictions on the options that Boyle, given his other intellectual commitments, had to work within. Intellectualist studies, on the other hand, do attempt to address this issue, but the most widely accepted intellectualist interpretation of his view of God and nature is, I shall argue, profoundly mistaken. Given Boyle's historical importance, and the centrality of the relationship between God and nature in his writings, it becomes crucial to have an accurate account of his views in this area.

The present paper is intended as a contribution to this goal. The inadequacy of previous studies is due in part to a failure to fully appreciate the philosophical resources Boyle inherited as a seventeenth-century natural philosopher. Whether he realized it or not, the problems involved in articulating

[6] This taxonomy is due to Shapin (1980). It should be pointed out, however, that the distinction is not an inviolable one, and that these approaches represent ends on a continuum with many studies falling somewhere in the middle. Thus it is not the case that scholars of an intellectualist orientation are oblivious to the social and political context of their subject, nor that scholars of a social contextualist persuasion do not consider what are above termed properly intellectual considerations. Indeed, in one place James Jacob (1977), a leading social contextualist, makes a remark which could easily serve as a motto for the present paper: "Boyle's natural philosophy as it evolved in the 1660s was, like the ideology of the Royal Society with which it merged, the product in part of some competing philosophies and theologies. Since he defined his own thought then in terms of these others, one of the best ways of understanding it and its origins would seem to be to study it in relation to this context of competing ideas—especially as this has never been done before" (159). Intellectualist and social contextualist writers differ mainly in the weight they place upon considerations of each sort, and in the relationship they see obtaining between such considerations. Social contextualists tend to view social and political factors as more fundamental than scientific, metaphysical, and theological considerations, and may interpret the latter considerations as parts of the social context. One of the points I wish to make in this paper is that intellectualist considerations have explanatory and expository value of their own, and therefore that they need not be seen as derivative from social and political factors.

the relationship between God and nature were bequeathed to him by the interaction of Christian theology and Aristotelian philosophy of nature in the Middle Ages. The metaphysical concepts, distinctions, and terminology he used and modified in the light of his own preferred ontology were not developed by him out of whole cloth, but were transmitted from the medievals to him in various indirect routes.[7] In seeking to clarify and understand his writings on God and nature there is, therefore, no substitute for tracing this issue back to its roots in medieval discussions and controversies. The results of our discussion based upon this strategy will be a more accurate understanding of Boyle's view of the relationship between God and nature, and a greater appreciation of the importance of properly philosophical factors in historiography.

In order to focus the following discussion I wish to set out at the start what I take to be the erroneous, but widely accepted, intellectualist interpretation of Boyle's view found in J. E. McGuire's 1972 article, "Boyle's Conception of Nature."[8] McGuire's explicit aim is to correct an imbalance he sees in the historiography of late seventeenth-century British natural philosophy. The "received opinion" holds that "the natural philosophers of the late seventeenth century viewed God's relation to nature as primarily a first efficient cause." A number of consequences are said to follow from this interpretation. First, "emphasizing God's role as first efficient cause makes nature . . . relatively independent of God." Second, "scientific knowledge establishes nature as a self-contained, self-regulating, law-governed system which can be likened in its interrelations to a machine." Finally, the claim is made that "as nature came more and more to be conceived as a system of laws relating matter and motion, the doctrine of divine providence declined in importance . . . in natural philosophy."[9]

Against this reading he attempts to establish an alternative interpretation which takes as its foundation the thesis that Boyle's "mechanical philosophy"

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[7] And perhaps by various direct routes as well. Not infrequently in the *Origin of Forms and Qualities* (1666) he quotes from the Latin texts of medieval scholastic treatises like Aquinas' commentary on Aristotle's *De Generatione et Corruptione* and Suarez's *Disputationes Metaphysicae,* of which he apparently had the 1630 Mainz edition. In his essay *Of the Reconcileableness of Reason and Religion* (1675) he criticizes some modern followers of Epicurus for their ignorance of "the Peripatetick arguments of Scotus and Aquinas." (*Works,* 4: 152–53) The conclusion seems unavoidable that he was at least familiar with the issues discussed and the solutions proposed by such philosophers to the problem of understanding God's relation to nature.

[8] McGuire's paper is frequently cited, but without any hint of its deficiencies. See, for example, J. Jacob (1977); E. M. Klaaren; M. A. Stewart, *Selected Philosophical Papers of Robert Boyle* (Manchester: Manchester University Press, 1979). A similar view is expressed in Gary B. Deason, "Reformation Theology and the Mechanistic Conception of Nature," in David C. Lindberg and Ronald L. Numbers, eds., *God and Nature* (Berkeley: University of California Press, 1986), 167–91.

[9] McGuire, 524.

is, in part, "a reformulation of a nominalist ontology" which holds that "nature contains non-related particulars." On this view "physical laws are categories imposed upon nature by the human mind in the light of the observed regularities of experience." From such premises McGuire derives the following interpretation:

> Since a nominalist ontology conceives particulars as unrelated, they are denied the power to cause change in and of themselves. God's will, therefore, is the only causally efficacious agency in nature. Hence there are no laws or causal connections in nature existing as entities over and above particulars conceived as events, bodies, or particles. . . . Thus nature conceived as a contingent artifact of eternal power is totally dependent on Providence such that it is the mere exemplification of rules or laws continually imposed by the latter. . . . Hence there are no secondary causes in nature which are miraculously dispensed with by Providence; rather, Providence is God's continual action in nature.[10]

Leaving aside the initial assumption that Boyle embraced a "nominalist ontology" (since it is not at all clear precisely what this ascription amounts to), I wish to focus on the central question raised by this interpretation. Are there, or are there not, on Boyle's view, any "secondary causes" in nature? That is, do natural entities exercise any genuine causal power? Or is God's will the only causal agency in nature? Against the "received opinion" that for Boyle God's relation to nature is merely as first efficient cause, and consequently that nature, once created, operates machine-like relatively independent of God, McGuire deduces an interpretation according to which natural entities are denied causal power of their own, and thus all that happens in nature must be ascribed to God alone. These two interpretations stand at opposite extremes from one another. Neither, I shall argue, does justice to Boyle's view. To show this it will first be necessary to explicate what is involved in each of these views in some detail.

1. THE "RECEIVED OPINION"

For the purposes of this paper the "received opinion" McGuire rejects will be referred to as *deism*. It is important to point out that this term has been associated with several different doctrines, only one of which is relevant here. On the one hand there is what can be termed "metaphysical deism." This is the technical philosophical view according to which God, or a First Cause, created the matter of the universe, instituted immutable and universal laws of nature that preclude alteration, and thereafter does not interact with the natural world. This view is primarily concerned to deny God's continued causal activity in nature. On the other hand there is what might be called

[10] ibid., 525–26.

"historical deism." The historical deists (mainly in the seventeenth and eighteenth centuries) did not, unlike metaphysical deists past and present, altogether deny the immanence of God, but were primarily critical of "revealed religion," and thus tended to deny the necessity of special revelation in favor of "natural religion," i.e., religion universally achievable by human reason. The opponent here was not divine causality in nature *per se*, but rather religious dogma as propagated by ecclesiastical institutions and authorities.[11] Regardless of whatever relationships may exist between them, these two versions of deism focus on different concerns. At issue here is the propriety of interpreting Boyle as a *metaphysical* deist. To avoid needless confusion it will be well to bear this point in mind in the following discussion.

In order to fix clearly in our minds the meaning of metaphysical deism, it will be useful to consider its medieval formulation and some of the arguments brought forth in its behalf. In his commentary on the "Sentences" of Peter Lombard, William Durandus de Saint-Pourcain (c. 1270–1332) defended a minimal role for God's activity in the ordinary course of nature.[12] On his view, God creates "secondary agents" (God being the "primary agent") and conserves them and their powers in existence.[13] Given the appropriate circumstances, the secondary agent will exercise its power and thereby bring about a certain characteristic effect without further assistance from God.

His arguments for this view were based on a consideration of the genuine difficulties involved in understanding how God and a secondary cause could both be said to be immediately responsible for the same effect. If God acted immediately in the production of the effect of a secondary cause, then He would either act by the *same* action by which the secondary cause acts or by a *different* action. But not by the same action, Durandus argued, for two reasons. First, a creature can perform its characteristic action(s) without God's special

[11] See E. C. Mossner, "Deism," in Paul Edwards, *The Encyclopedia of Philosophy* (New York: Macmillan/The Free Press, 1967), vol. 2, pp. 326–336.

[12] William Durandus, *In Petri Lombardi Sententias Theologicas Commentariorum Libri IIII.* (Venetiis, ex Typographia Guerraea, MDLXXI) Disputation 5, Question 1. (republished in 2 Vols.: Ridgewood, N.J.: Gregg Press, Inc., 1964. See 130d–131d).

[13] We can also distinguish, as Durandus did not, between a "strong" and a "weak" form of deism, depending on whether or not it is thought that God must conserve an entity and its powers in existence in order for that entity to exercise its causal powers. The weak deist holds that for any created entity such that it has the power to act causally, God conserves this entity and its power in existence. This version is based on the conviction that natural entities are characterized by a radical contingency such that they would cease to exist were God withdraw his conserving power for even an instant. By "assuming the conservation of its nature and active power" (see below) Durandus sides with weak deism. The strong deist holds that God need not conserve such an entity in existence for it to exercise its causal power. Once created, it persists in being without God's conserving power. Weak deists are "conservationists," we might say, whereas strong deists are not.

influence (assuming the conservation of its nature and active power), since an action which does not exceed the power of the species of the agent is sufficiently elicited by just the power of the species; therefore, it would be superfluous to posit another immediate principle eliciting such an action. Second, it is impossible for numerically the same action to be from two or more agents in such a way that it is *completely* and *immediately* from each, unless they act by the same power (i.e., by the same nature); but God and a creature cannot act by numerically the same power. So God and a secondary cause do not act by the same action.

On the other hand, God and a secondary cause also cannot act by different actions in the production of the effect of a secondary cause. This is also supported by two reasons. First, if God and a secondary cause acted by different actions, then either one of the actions effects the thing produced before the other does, or else both effect it simultaneously. Not the former, because if God by His action produced the whole thing first, then the creature would bring about nothing by its subsequent action, and vice versa. Nor can it be said that God produces a part of the effect and the creature a part, for then we must ask whether that very part which the creature produces immediately is also such that God produces it immediately, and the same problem arises all over again. On the other hand, it is not the case that both actions bring about the same effect simultaneously, because then one of the two actions would be superfluous. Besides, two actions cannot have the same terminus, because actions are discriminated by their termini; if God's action had the same terminus as the secondary cause's, then the actions would not be distinct. But this is impossible. Hence, Durandus concludes, God does not act immediately in the production of the effect of a secondary cause. It follows that secondary causes act by their own power in bringing about their effects.[14]

The soundness of these arguments is not our concern here.[15] The important points to take note of are the position Durandus defends, and the kinds of considerations upon which it is grounded. He holds that secondary agents exercise their power and bring about characteristic effects without any direct assistance from God. For every effect that is brought about in nature, it is not the case that God has to be acting *immediately* in the production of that effect.[16] This view is based on logical and conceptual considerations pertaining to the difficulty of seeing how a natural effect can be immediately caused by both

[14] Durandus, Disputation 5, Question 1.

[15] A question arises as to whether Durandus equivocates in his criterion for individuating actions. Are actions individuated by the powers that produce them or by their termini, i.e., effects?

[16] This is not to say, however, that God need not have acted at some *previous* time for the effect in question to be realized now. On Durandus' view God is not a *proximate* cause of the effect.

God and a creature. Durandus solves the problem by denying that God is the immediate cause of every natural effect. The possibility remains open, however, to adopt the other obvious solution by denying that natural entities are the causes of the effects associated with them, and consequently that God is the immediate and sole cause of every natural effect. This is the central doctrine of *occasionalism.*

2. MCGUIRE'S INTERPRETATION

Occasionalism is sometimes introduced in histories of philosophy as if it were merely a desperate attempt to save Cartesianism from the mind-body problem. For this reason Nicolas Malebranche (1638–1715) is the thinker most often associated with this doctrine.[17] Actually this position was most fully developed in the medieval period by al-Ghazali (1058–1111), an Islamic thinker, in order to provide a philosophical justification for the possibility of miracles, and by Gabriel Biel (1410–1495), a Catholic (like Malebranche), in order to explain the metaphysics of transubstantiation.[18] According to all these thinkers there are no causal agents in nature besides God (or, perhaps, other moral agents). The distinction between "primary" and "secondary" causes is really superfluous since there is only one cause for all that happens—God's will. Despite popular belief and appearances to the contrary, natural entities make *no* causal contributions to the phenomena usually associated with them. Even "passive" causal contributions are precluded on this view: Not only are there no creatures which can *act* so as to bring about a given effect, but there are not even any essential natures associated with things in nature which restrict the range of effects that follow from their being *acted upon.*

Al-Ghazali's arguments in support of occasionalism are illustrative of the considerations that could be mustered in its behalf. His aim was to refute the view, held by certain "heretics of our time" (i.e., Moslem philosophers, notably al-Farabi and ibn-Sina [Avicenna]), that a departure from the natural course of events is impossible. Such a position was recognized as denying the possibil-

[17] For an expression of his occasionalism see Book Six, Part Two, Chapters 1–3 (437–52) of his *The Search after Truth,* and Elucidation Fifteen (657–85) of his *Elucidations of the Search after Truth,* translated from the French by Thomas M. Lennon and Paul J. Olscamp (Columbus: Ohio State University Press, 1980).

[18] Al-Ghazali, *Tahafut al-Falasifah: The Incoherence of the Philosophers,* translated into English by Sabih Ahmad Kamali (Lahore: Pakistan Philosophical Congress, 1963). See Problem XVII, pp. 185–196 ("Refutation of their Belief in the Impossibility of a Departure from the Natural Course of Events"). Gabriel Biel, *Collectorium circa Quattour Libros Sententiarum.* Auspiciis Hanns Ruckert collaborantibus Martino Elze et Renata Steiger, ediderunt Wilfridus Werbeck et Udo Hofmann (Tubingen: J.C.B. Mohr [Paul Siebeck]). See Book IV, Part 1, Dist. 1, part 1.

ity of miracles, such as the story related in Chapter 3 of the book of Daniel (which al-Ghazali accepted), in which three young men are thrown into a blazing furnace (which consumes their guards), yet emerge unharmed. Al-Ghazali attributed the disbelief in such a miracle to an uncritical acceptance of Aristotle, whose views seemed to entail that natural entities such as fire were possessed of necessary properties whose effects, in normal circumstances, could not be impeded.

His response was to argue that "the connection between what are believed to be the cause and effect is not necessary." "Take for instance any two things, such as . . . burning and contact with fire. . . . They are connected as the result of the Decree of God (holy be His name), which preceded their existence. If one follows the other, it is because he has created them in that fashion, not because the connection in itself is necessary and indissoluble."[19] Suppose that we take a piece of cotton and place it in a flame. The philosophers claim that "the fire alone is the agent of burning, and that being an agent by nature (not by choice), it cannot refrain from doing what is its nature to do—after it comes into contact with a subject which is receptive to it." This is precisely what al-Ghazali denies: "We say that it is God who . . . is the agent of blackness in the cotton, of the disintegration of its parts, and of their transformation into a smouldering heap of ashes." Fire, as an inanimate thing, has no power to bring about effects. The only argument to the contrary is from the observation of the fact of burning at the time of contact with fire. "But observation only shows that one is *with* the other, not that it is *by* it and has no other cause than it."[20] It follows that since God is the cause of every event that happens in nature, there is no reason to doubt that miracles are possible. Miracles are simply instances where God (who is completely free) chooses to act in a way which is contrary to our ordinary experience.

It is important to be quite clear about the view being propounded here. When the cotton is placed in the flame, the fire makes no causal contribution at all to the blackening of the cotton. The phenomenon is completely the result of God's will. Since God's will is free He could, if He so desired, make the cotton turn into a personal computer over the fire.[21] That He does not can

[19] Al-Ghazali, 185.

[20] ibid.

[21] Al-Ghazali uses more homely examples to illustrate this point: "One who left a book in his house might return to find it transformed into a slave-boy intelligent and resourceful; or into an animal. Or having left a slave-boy in the house, one may return to find him transformed into a dog. . . . And when asked concerning the change, he may say: 'I do not know what is now in the house. All I know is that I left a book there. Perhaps now it has turned into a horse, defiling my library with its excrement.' " The possibilities on this view, evidently, are only limited by one's imagination: "So one who sees a man whom he had not seen until now might hesitate to guess

be explained only on the supposition that He acts in a consistent manner (which we mistakenly regard as immutable "laws of nature") so that we humans can get along reasonably well in the world. One of the consequences of this view is that natural entities do not have "natures" in the sense of necessary properties associated with them. Fire is no more hot than is ice. It is simply that in the presence of fire, God raises the temperature of nearby objects. Nature, on this view, is completely inert and consequently entirely dependent on God's causal power for its diverse phenomena.[22]

McGuire adopts an occasionalist interpretation of Boyle in order to overthrow the "received opinion." It must be admitted that he claims early on in his paper that he is *not* equating Boyle's position with occasionalism: "The 'mechanical philosophy' of Boyle and other seventeenth-century thinkers . . . must be sharply distinguished from the philosophies of nature associated with . . . the occasionalism of Malebranche, and the idealism of Berkeley."[23] He understands Malebranche's solution to the problem of the relationship between God and nature quite well: "Malebranche . . . developed an occasionalist solution to the problem. [He] denied transeunt causation among physical phenomena. . . . God is the only causally active agent in nature. . . . For Malebranche, since God is the true cause, all 'natural causes' are merely 'occasions' of Divine will."[24] A little later he states that "[Boyle] did not accept occasionalism."[25]

Yet one wonders whether McGuire really understands what occasionalism is. Throughout the remainder of his paper he makes remarks which indicate that he thinks that for Boyle as well nature is completely inert, having no causal power whatsoever. For Boyle, "The laws of phenomena and their properties are not interrelated."[26] For both Boyle and Berkeley "only God can act causatively."[27] "Since there are no agents on nature [for Boyle], there can be no true causation in the physical realm. Like Berkeley after him, Boyle adheres to the doctrine that only moral agents, responsible for their behavior, are capable of

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whether that man was born at all. He might say: 'Maybe, this man was one of the fruits sold in the market. But now the fruit has been transformed into a man, because God has power over every thing, and all such transformations are therefore possible' " (189). Fortunately, however, although all these things are possible, "God has created for us the knowledge that He would not do these things" (ibid.).

[22] For a classic response to al-Ghazali's *Tahafut al-Falisifah: The Incoherence of the Philosophers,* see ibn-Rushd (Averroes) (1126–1198), *Tahafut al-Tahafut: The Incoherence of The Incoherence,* translated from the Arabic with introduction and notes by Simon van den Bergh (London: Luzac, 1954), especially q. 17.

[23] McGuire, 525.

[24] ibid., 531.

[25] ibid., 532.

[26] ibid., 528.

[27] ibid., 537.

causative action."[28] He concludes: "Thus, though physical objects appear to act so as to bring about changes, in reality true causal power cannot be ascribed to them. Therefore Boyle implicitly expressed the view that causation is something imposed upon observed regularity in nature by the conceptualizing power of the human mind."[29] The almost point-for-point correspondence of McGuire's interpretation with al-Ghazali's view is arresting.

One could take issue with McGuire's interpretation on several grounds.[30] The most damaging is the exegetical point that it fails to account for the numerous passages in Boyle's writings which undoubtedly gave rise to the "received opinion" in the first place—those passages in which he appears to minimize God's immediate causal activity in nature. An examination of texts from his most sustained treatment of the relationship between God and nature reflecting his mature views on the subject—*A Free Inquiry into the Vulgarly Received Notion of Nature* (1686)—bears this out.[31] The following passage is

[28] ibid., 536.

[29] ibid.

[30] One of these, which I do not intend to dwell on here, is his use of texts from Boyle's works. He sometimes fails to read a given passage in context. For example, on pages 535–36 of his paper he gives a quote from *The Christian Virtuoso* to support his interpretation. He fails to mention that in the passage in question Boyle is informing the reader of what the *Cartesians* hold, and that from the context it is not clear what Boyle thought about this. Another problem consists in paying attention to only part of a given text. In the same quote, for example, he emphasizes that local motion is "every moment continued and preserved immediately by God," which naturally lends itself to an occasionalist reading, but ignores the rest of the passage where Boyle infers from this that God "concurs to the actions of each particular agent," which suggests that agents other than God have causal power. In this paper I want to focus not on these shortcomings of McGuire's article, but rather on the adequacy of the interpretation he proposes for understanding the view of God and nature expressed in Boyle's writings.

[31] Robert Boyle, *A Free Inquiry into the Vulgarly Received Notion of Nature* (1686), in *The Works of the Honourable Robert Boyle,* Vol. 5 (London, 1772). This is a six volume resetting of the 1744 edition edited by Thomas Birch. This edition will hereafter be referred to as *Works.* Since my arguments throughout this paper will be based largely on what it is possible to infer from Boyle's published writings, something should be said about the texts I am using. I am sensitive to the complaint, made by an anonymous referee for this journal, that it is very eccentric to use an inauthoritative eighteenth-century edition of a seventeenth-century author for a twentieth-century reader. However, I am also persuaded by M. A. Stewart's argument (in the Preface to his *Selected Philosophical Papers of Robert Boyle,* Manchester: Manchester University Press, 1979) that at this time it is not clear that any replication of Boyle's original editions would be authoritative in the sense of being virtually free of error, for the simple reason that they were not often well prepared either for or by the printer. The 1772 edition used here is likely to differ from a final critical edition mainly in such incidentals as spelling, punctuation technique, and typographic conventions. For our purposes it is not crucial to have in our possession a critical edition of Boyle's works. Because the argument of the present paper is built from a consideration of many passages from several of Boyle's treatises, it is unlikely that slight differences from one edition to another would have a bearing on the substance of this paper. I can only beg readers to point out to me any places where a more authoritative edition would materially affect the interpretation proposed here.

typical: "I ascribe to the wisdom of God in the first fabric of the universe, which he so admirably contrived, that, if he but continue his ordinary and general concourse, there will be no necessity of extraordinary interposition, which may reduce him to seem, as it were, to play after-games; all those exigencies, upon whose account philosophers and physicians seems to have devised what they call nature, being foreseen and provided for in the first fabric of the world."[32] Such a view, he thinks, besides being true, also does more honor to the Creator than any other:

> [A]s it more recommends the skill of an engineer to contrive an elaborate engine so, as that there should need nothing to reach his ends in it but the contrivances of parts devoid of understanding, than if it were necessary, that ever and anon a discreet servant should be employed to concur notably to the operations of this or that part, or to hinder the engine from being out of order; so it more sets off the wisdom of God in the fabric of the universe, that he can make so vast a machine perform all those many things, which he designed it should, by the meer contrivance of brute matter managed by certain laws of local motion and upheld by his ordinary and general concourse, than if he employed from time to time an intelligent overseer, such as nature is fancied to be, to regulate, assist, and controul the motions of the parts.[33]

To make his view more vivid he appeals time and again to the clock metaphor which crops up so often in seventeenth-century writers.[34]

> [A]ccording to us, [the world] is like a rare clock, such as may be that at *Strasburgh*, where all things are so skilfully contrived, that the engine being once set a moving, all things proceed, according to the artificer's first design, and the motions of the little statues, that at such hours perform these or those things, do not require, like those of puppets, the peculiar interposing of the artificer, or any intelligent agent employed by him, but perform their functions upon particular occasions, by virtue of the general and primitive contrivance of the whole engine.[35]

On McGuire's occasionalist interpretation natural entities are denied power of any sort. That Boyle thinks natural entities do have power, in transmitting

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[32] *Free Inquiry*, *Works*, 5: 163.

[33] ibid., 162.

[34] Cf. Larry Laudan, "The Clock Metaphor and Hypotheses: The Impact of Descartes on English Methodological Thought, 1650–1670," in his *Science and Hypothesis* (Dordrecht: D. Reidel, 1981), and Rose-Mary Sargent, "Robert Boyle's Baconian Inheritance: A Response to Laudan's Cartesian Thesis," *Studies in History and Philosophy of Science* 17, no. 4 (Dec 1986): 469–86.

[35] *Free Inquiry*, *Works*, 5: 163. It is worth noting that the clock metaphor in this passage is being favorably contrasted in the immediately preceding text with a different metaphor which is better suited to convey the essence of occasionalism: "[M]ethinks the difference betwixt their [certain philosophers'] opinion of God's agency in the world, and that, which I would propose, may be somewhat adumbrated by saying, that they seem to imagine the world to be after the nature of a puppet, whose contrivance indeed may be very artificial, but yet is such, that almost every particular motion the artificer is fain (by drawing sometimes one wire or string, sometimes another) to guide and oftentimes over-rule the actions of the engine."

motion to one another, is evident in the following passage: "[I]t is intelligible to me, that God should at the beginning impress determinate motions upon the parts of matter, and guide them, as he thought requisite, for the primordial constitution of things; and that ever since he should, by his ordinary and general concourse, maintain these powers, which he gave to the parts of matter, to transmit their motion thus and thus to one another."[36] In a striking passage he sums up the view he is proposing: "According to the foregoing hypothesis, I consider the frame of the world already made, as a great, and, if I may so speak, pregnant automaton, that . . . in conjunction with the laws of motion, freely established, and still maintained by God, among its parts, I look upon as a complex principle, whence result the settled order or course of things corporeal."[37]

Such passages, which attribute power to the "parts of matter," must be counted as anomalies on McGuire's interpretation.[38] Unless we are willing to exercise an inordinate amount of interpretative creativity in our analysis of such texts, the inescapable conclusion is that Boyle accepted secondary causation in the natural realm. It would be a mistake to conclude from this, however, that the "received opinion" is right after all, and that he embraced metaphysical deism. If we take seriously his remarks about the necessity of God's "ordinary and general concourse" for maintaining the laws of motion, then God's causal activity in nature entails more than merely the conservation of individual things in existence. Such an admission rules out metaphysical deism in the strict sense. A satisfactory interpretation of Boyle's writings on God and nature must do justice to both divine and secondary causal contributions to natural phenomena. Both McGuire's and the received opinion's interpretations err by acknowleding only part of the causal picture. Is it possible to do better?

3. BOYLE AS A CONCURRENTIST

I think it is possible to do better. Appreciating the subtlety of Boyle's view requires, once again, familiarity with the detailed consideration the problem received at the hands of certain scholastic philosophers. The extreme positions of deism and occasionalism are not the only solutions historically available. Understanding a third philosophical option on this question will help us to bring Boyle's view into clearer focus.

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[36] ibid., 170.

[37] ibid., 179.

[38] See also *The Origin of Forms and Qualities According to the Corpuscular Philosophy*, *Works*, 3: 42: "For the world being once constituted by the great Author of things as it now is, I look upon the phaenomena of nature to be caused by the local motion of one part of matter hitting against another."

The view of the relationship between God and nature that I wish to describe here may be called *concurrentism* (from the Latin *concursus*, literally "running together"). In the medieval period the best known spokesman for this view was Thomas Aquinas (1225–1274).[39] An interestingly different version was developed in the early modern period by Luis de Molina (1535–1600).[40] A host of other scholastic philosophers developed variations on these two approaches.[41]

Concurrentism in any of its versions can be understood as an attempt to cut a middle way between the extremes of deism and occasionalism by recognizing the causal contributions made to natural phenomena by both God and natural entities. On the one hand, it was clear to thinkers such as Aquinas that natural entities do, contrary to occasionalists like al-Ghazali, make some characteristic causal contributions to the phenomena usually associated with them. "Some have understood God to work in every agent in such a way that no created power has any effect in things, but that God alone is the immediate cause of everything wrought; for instance, that it is not fire that gives heat, but God in the fire, and so forth."[42] But this, he says, is impossible. To begin with, it is evident to the senses that effects follow from the causal properties of things. We *observe* that the fire causes the cotton to turn black.[43] In addition, it is rationally fitting that things in nature bring about effects, since it would be contrary to the divine wisdom that there should be anything useless in the created realm. "Indeed, all things created would seem, in a way, to be purposeless, if they lacked an operation proper to them; since the purpose of everything is its operation."[44] On the other hand, granting *all*-sufficiency to the causal powers of natural entities, as metaphysical deists do, has the undesirable consequence of making God seem irrelevant to goings on in the physical order. Only one conclusion seemed possible: "We must therefore understand

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[39] Saint Thomas Aquinas, *Quaestiones Disputatae de Potentia Dei* (*On the Power of God*), Question 3, Article 7; *Summa contra Gentiles* Book III, Part 1, chaps. 64–67, 69, 70, 75–77; and *Summa Theologiae*, Book I, Questions 103 and 105.

[40] Luis de Molina, *Liberi Arbitrii cum Gratiae Donis, Divina Praescientia, Providentia, Praedestinatione, et Preprobatione* (*Concordia*) (Oniae: Collegium Maximum S.I., 1953), Part II, Disputations 25–28.

[41] See also Francisco Suarez (1548–1617), *Disputationes Metaphysicae* (Hildesheim: Georg Olms Verlagsbuchhandlung, 1965), Disputations 18, 22; as noted above, Boyle quotes extensively from this work; Johannes Duns Scotus (1265–1308), *Quaestiones Quodlibetales—God and Creatures: The Quodlibetal Questions*, translated with an introduction, notes, and glossary by Felix Alluntis and Allan B. Wolter (Princeton: Princeton University Press, 1975); William of Ockham (1285–1349), *Reportatio* II, q.3 (especially pp. 60–66, 70, and 72–75) in G. Gal and R. Wood, eds., *Ockham: Opera Theologica*, vol. 5, St. Bonaventure, N.Y., 1981).

[42] *Summa Theologiae* q. 105, a.5.

[43] *Summa contra Gentiles* Book III, part 1, chap. 69.

[44] ibid.

that God works in things in such a manner that things have also their proper operation."[45]

It was then incumbent on Aquinas to articulate the nature of the contributions by God and natural entities, and how these could be integrated in the causation of natural phenomena. His solution is encapsulated in the following statement: "God is the cause of everything's action inasmuch as he gives everything the power to act, and preserves it in being and applies it to action, and inasmuch as by his power every other power acts."[46] On this view God can be said to "assist" a secondary cause's action in four ways:

(1) God gives the secondary cause its intrinsic power. (creation)
(2) God conserves the secondary cause's intrinsic power. (conservation)
(3) God applies the secondary cause's intrinsic power to its characteristic effect. (application)
(4) God supplies needed extrinsic power to the secondary cause. (operation)[47]

Creation is the bringing into existence of a natural entity belonging to a determinate species of thing, complete with the powers usually associated with that sort of thing. Conservation of a secondary cause is the maintenance of that thing in existence; this is required because of the essential contingency of all created things. Application involves God directing the secondary cause to its appropriate end, and thus doing something *to* the secondary cause. Operation involves God further empowering the secondary cause, and acting *through* the secondary cause to bring about the given effect. (A deist like Durandus would accept both creation and conservation in these terms, but would reject divine application and operation.) Aquinas' view can be understood by way of an analogy. In order for a pen to function in writing it must both begin to exist as an instrument suitable for writing and continue to exist as such from moment to moment. But if it is to bring about a specific effect it must also be applied to some writing surface and be moved in a certain way. The person (who is a principle cause) acts through the pen (the instrumental cause) to produce the written words (the single effect).

> Because an instrument is in a manner the cause of the principal cause's effect, not by its own form or power, but in so far as it participates somewhat in the power of the principal cause through being moved thereby: thus the axe is the cause of the craftsman's handiwork not by its own form or power, but by the power of the craftsman who moves it so that it participates in his power. . . . Just as it clearly cannot be given to the

[45] *De Potentia* q.3, a.7.

[46] ibid.

[47] ibid., and *Summa Theologiae*. In the *Summa contra Gentiles* the distinction between "application" and "operation" is collapsed.

craftsman's instrument to work unless it be moved by him, so neither can it be given to a natural thing to operate without the divine operation.[48]

Application and operation by God are necessary because the secondary cause, on Aquinas' view, lacks the power to move itself to action. "In every agent, in fact, there are two things to consider: namely, the thing itself that acts, and the power by which it acts."[49] In natural entities, at least, these two things are distinct. It is *not* the case on this view, he emphasizes, that the same effect is attributed to a natural cause and to divine power in such a way that it is partly done by God, and partly done by the natural agent. Rather, "it is wholly done by both, according to a different way, just as the same effect is wholly attributed to the instrument and also wholly to the principal agent."[50] In this way he hopes to preserve the integrity of both divine and secondary causation in nature.

Molina agreed with Aquinas that both God and secondary causes contribute to the production of natural phenomena, but denied that in bringing about a given effect God acts on and through a secondary agent. He takes issue with Aquinas' analogy by pointing out that there are two kinds of instruments through which an agent might work. One sort requires constant operation and application of a principal agent in order to produce the effect. "There are some which do not have the full power to operate, such as the instruments of the artist. And these require the motion and direction of some other agent in order to effect anything."[51] The second sort of instrument, of which semen from a father and heat from a fire are the examples he mentions, has its own power to act independently of its agent. "And if instruments of this sort are aptly positioned, they require no additional motion or direction from the principal causes."[52] He points out that in the former case it is clear that the instrument does not contain the whole power to act and so it cannot truly be said that the effect proceeds wholly from it, even on its own order of causality. If natural causes are of the latter sort, however, then God's assistance is unnecessary since they may produce their effect even after the agent has ceased to exist. In short, Molina thinks, Aquinas' analogy fails because either natural entities are not truly the causes of the effects associated with them, being mere instruments in God's hand, or else they require no assis-

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[48] *De Potentia*, q.3, a.7, reply to seventh objection; cf. *Summa contra Gentiles* Book III, part 1, chap. 70.

[49] *Summa contra Gentiles* Book III, part 1, chap. 70.

[50] ibid.

[51] *Concordia*, part II, q. 14, disp. 26.

[52] ibid.

tance from God in order to bring about their effects, in which case God's assistance is unnecessary. Neither is a satisfactory result.

On Molina's view a secondary cause is not a true cause unless it can move itself without first being moved by another. His own account of concurrence is therefore founded on an analogy of cooperation between God and secondary causes: They act simultaneously and in virtue of their actions taken together they produce a given effect. The natural entity's contribution consists in the exercise of its specific powers to bring about the effect. God's contribution consists of conserving the *effect* brought about by the secondary cause. (Thus Molina's view would differ, if only slightly, from the deistic view which focuses only on God's conservation of the secondary causes in existence.) Unlike the Thomistic view according to which God and the natural cause are each said to be sufficient conditions for the effect, on the Molinist view the action of each is a necessary condition for the production of the effect, and together they are sufficient. "It follows that God's general concurrence is *not* an action of God's *on* the secondary cause, as though the secondary cause acted and produced its effect after having been moved; rather, it is an action immediately *with* the cause *on* its action and effect."[53]

An interesting feature of Molina's view is that there is a kind of pre-established harmony between God's action and that of the secondary cause. God foreordained from eternity to conserve the effect of a secondary cause at the instant the secondary cause brings it about. This is true even in the case of miracles, "in which He who foreknows all future things has by the eternal determination of His will decided to suspend the influence in question and in the service of some higher end to miraculously withhold that influence from the secondary causes."[54] This account of concurrence-as-cooperation plays a central role in his explication of the miracle recorded in Daniel: "If God did not cooperate with a secondary cause, He surely would not have been able to bring it about that the Babylonian fire did not burn the three young men. . . . Therefore, . . . it should be claimed without doubt that God cooperates with secondary causes, and it was only because God did not concur with the fire in its action that the young men were not consumed by the fire."[55]

In summary, Aquinas and Molina sought to articulate views according to which secondary causes are not superfluous (as they are in occasionalism), nor in which God's causal role in nature is minimized (as it is in deism). Concurrentism (in either of its forms) can be described as an attempt at a *via media*

[53] ibid.

[54] ibid.

[55] ibid., part II, q. 14, disp. 25.

between what were seen as unacceptable extreme positions. Although each of these views was fleshed out with many subtle details omitted in the foregoing sketch, enough has been said to permit us to see how Boyle's various remarks can be profitably interpreted along concurrentist lines.[56]

In order to construe Boyle as a concurrentist it must be shown that he understood events in nature to involve immedidate causal activity on the part of both God and natural entities.[57] In the criticisms of McGuire's interpretation above we saw several passages in which Boyle takes for granted that God and natural entities each play causal roles in nature, and such passages could be multiplied. In each he emphasizes that God's "ordinary and general concourse" is necessary to maintain the laws of motion governing the interactions of bodies. An intriguing clue bearing on the *nature* of this interaction is suggested in the following passage from his *Essay Containing a requisite Digression concerning those, that would exclude the Deity from intermeddling with Matter* (1663): "[T]he quill, that a philosopher writes with, being dipted in ink, and then moved after such and such a manner upon white paper, all which are corporeal things, or their motions, may very well trace an excellent rational discourse; but the quill would never have been moved after the requisite manner upon the paper, had not its motion been guided and regulated by the understanding of the writer."[58] Just as a pen, which is an inanimate thing, requires for its proper operation that its motion be "guided and regulated by the understanding of the writer," so too, Boyle says, the matter which makes up the universe, being suitably figured and moved, performs a great many things which it could not were it left to itself and not directed by an intelligent agent.[59] The similarity to Aquinas' view, right down to the analogy used to convey it, should not go unnoticed.

Besides such indirect evidence, there are other indications pertaining to the nature of Boyle's view. Recall that occasionalism was originally a response to the rejection of miracles based on adherence to a doctrine of the necessity

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[56] Problems and questions remain concerning the details of both of these views. On the Thomistic view both God and the natural entity are said to be sufficient conditions for the effect. But then it is difficult to see how one of the causes fails to be superfluous. On the Molinist view God and the natural cause cooperate together like two men pulling a boat. (See *Concordia*, part II, q. 14, disp. 25) But does this mean that God could not bring about the effect without the second cause? Doesn't this compromise God's omnipotence?

[57] The stronger modal claim to the effect that natural entities *cannot* bring about natural phenomena without God's assistance is not necessary in order to construe Boyle as a concurrentist. The present formulation is intended to be neutral on this question.

[58] *An Essay Containing a requisite Digression concerning those, that would exclude the Deity from intermeddling with Matter*, in *Some Considerations Touching the Usefulness of Experimental Natural Philosophy*, *Works* 2: 48.

[59] ibid.

of nature. Concurrentism, in turn, was developed as a response to occasionalism while trying to avoid the opposite error of supposing that natural entities produce effects independently of God assistance. As we saw with Molina, this required an account of how miracles are possible. How one understands God's *special* providence in the metaphysics of miracles, consequently, reflects one's understanding of the metaphysics of God's general providence.

In his treatise *Some Considerations about the Reconcileableness of Reason and Religion* (1675), Boyle writes:

> [I]f we consider God as the author of the universe, and the free establisher of the laws of motion, whose general concourse is necessary to the conservation and efficacy of every particular physical agent, we cannot but acknowledge, that, by with-holding his concourse, or changing these laws of motion, which depend perfectly on his will, he may invalidate most, if not all the axioms and theorems of natural philosophy: these supposing the course of nature, and especially the established laws of motion, among the parts of the universal matter, as those upon which all the phaenomena depend.[60]

Notice again the emphasis on the necessity of God's "general concourse" for the causal efficacy of every physical agent. This is the essence of his view of the manner of God's activity in the ordinary course of nature. He then immediately uses this doctrine to explain God's special providence in the protection and rescue of Daniel's friends: "It is a rule in natural philosophy, that *causae necessariae semper agunt quantum possunt;* but it will not follow from thence, that the fire must necessarily burn *Daniel's* three companions, or their clothes, that were cast by the Babylonian king's command into the midst of a burning fiery furnace, when the author of nature was pleased to withdraw his concourse to the operation of the flames, or supernaturally to defend against them the bodies, that were exposed to them."[61] Discussing this incident in his treatise on the Resurrection he writes:

> For, supposing the truth of the history of the scriptures, we may observe, that the power of God has already extended itself to the performance of such things, as import as much as we need infer, sometimes by suspending the natural actings of bodies upon one another, and sometimes by endowing human and other bodies with preternatural qualities. . . . Thus the operation of the activest body in nature, flame, was suspended in *Nebuchadnezzer's* fiery furnace, whilst *Daniel's* three companions walked unharmed in those flames, that in a thrice, consumed the kindlers of them.[62]

It is significant that in these passages he gives two alternative explanations for the possibility of the miracle. In the first he suggests that God "withdraw[s] his

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[60] *Some Considerations about the Reconcileableness of Reason and Religion, Works,* 4: 161.

[61] ibid., 161–62.

[62] *Some Physico-Theological Considerations about the Possibility of the Resurrection, Works,* 4: 201–202.

concourse to the operation of the flames" or "suspends" the fire's action. On this account God momentarily ceases to empower the fire. This is just the way that Aquinas would explain the miracle. Boyle also leaves open the possibility that in such a miracle God endowed the young men's bodies with special qualities which prevented the fire from having its effect on them. On this explanation the fire retains its natural power to burn, as is evidenced by the fact that the guards were consumed by it, but God does not cooperate with the flame in producing the same effect in the young men. As we saw above, this is the way Molina explains this miracle. Neither of these explanations would be admissible on the deistic view according to which God does not concur with the action of the flames in the first place, and does not alter physical laws after they have been established. Neither is admissible on the occasionalist view according to which the fire has no power of its own which God could withdraw his concourse from, and according to which there are no natural properties associated with bodies which could be replaced by supernatural properties. On the other hand, each explanation is just what one would expect if Boyle embraced some form of concurrentism.

The details of his concurrentism can be understood by turning to treatises, especially *The Origin of Forms and Qualities according to the Corpuscular Philosophy* (1666) and *The Excellency and Grounds of the Mechanical Hypothesis* (1674), in which he distinguishes his own view of secondary causation from that of his predecessors. Because he embraced a different ontology from that of Scholastic Aristotelians such as Aquinas and Molina, his version of concurrentism had to be reformulated in terms of his own philosophy of nature. Central to his "mechanical philosophy" was the thesis that the form of a thing is not a "real sub stance distinct from matter," as he understood the Scholastic doctrine as affirming, "but only the matter itself of a natural body, considered with its peculiar manner of existence." Because such a "convention of accidents" is sufficient to make a body the sort of thing it is, he appropriates for it the term 'Form'.[64]

Of the accidents constituting the forms of natural bodies, he considered local motion to be the most important, and explicitly connected it with secon-

[63] There is a very useful discussion of whether Boyle's doctrine should be thought of as a modification, or as the absolute antithesis, of Aristotle's doctrine in E. J. Dijksterhuis, *The Mechanization of the World Picture*, translated by C. Dikshoorn (Oxford: Oxford University Press, 1961), 437–39.

[64] *The Origin of Forms and Qualities according to the Corpuscular Philosophy*, *Works* III, pp. 28–29. See also *Free Inquiry*, *Works*, 5: 177: "[T]he particular nature of an individual body consists . . . in a convention of the mechanical affections (such as bigness, figure, order, function, contexture, and local motion) of its parts, (whether sensible or insensible) convenient and sufficient to constitute in, or to intitle to, its particular species or denominations, the particular body they make up, as the concourse of all of these is considered as the principle of motion, rest, and changes in that body."

dary causation: "[L]ocal motion seems to be indeed the principal amongst second causes, and the grand agent of all that happens in nature: for though bulk, figure, rest, situation, and texture do concur to the phaenomena of nature, yet in comparison of motion they seem to be in many cases, effects, and in many others little better than conditions, or requisites, or *causes sine quibus non*, which modify the operation that one part of matter by virtue of its motion hath upon another."[65] On this view local motion is the chief determinant of the form of a natural body. The form, in turn, determines the qualities associated with that sort of body. The laws governing local motion, however, are not intrinsic to matter once it has been created, but require God's continued activity for their preservation: "[T]he universe being once framed by God, and the laws of motion being settled and all upheld by his incessant concourse and general providence, the phaenomena of the world thus constituted are physically produced by the mechanical affections of the parts of matter, and what they operate upon one another according to mechanical laws."[66]

God's contribution to the natural order is thus twofold. On the one hand He created matter at the beginning and set it in motion in such a way that an organized universe would be formed. After this initial creative act He continues to sustain the order of the universe by maintaining the laws of motion which govern the mechanical interactions of the parts of matter. God's "incessant concourse and general providence" consists in conserving these laws of motion, and consquently the effects associated with natural bodies.[67] Natural bodies can be said to possess causal powers in virtue of the motion they can impart to one another through impact, but they are incapable of sustaining the lawful order of the universe without the continued assistance of God.[68] God and natural entities each play a significant causal role in a physical universe conceived within the ontological categories of the mechanical philosophy. Accordingly, this view can most aptly be described, by borrowing a phrase from Boyle, as concurrentism "reconciled and accomodated to the notions of the corpuscular physicks."[69]

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[65] *The Origin of Forms and Qualities according to the Corpuscular Philosophy*, *Works*, 3: 15.

[66] *About the Excellency and Grounds of the Mechanical Hypothesis*, *Works*, 4: 68–69.

[67] See also *The Origin of Forms and Qualities according to the Corpuscular Philosophy*, *Works*, 3: 42: "The world being once constituted by the great Author of things as it now is, I look upon the phaenomena of nature to be caused by the local motion of one part of matter hitting against another."

[68] This is perhaps what he is suggesting when he writes that he "cannot conceive, how a body devoid of understanding and sense, truly so called, can moderate and determine its own motions, especially so, as to make them conformable to laws, that it has no knowledge or apprehension of." (*Free Inquiry*, *Works*, 5: 170).

[69] *The Origin of Forms and Qualities according to the Corpuscular Philosophy*, *Works* 3: 5.

4. CONCLUSIONS

I wish to return briefly to the issues raised in the introduction to the foregoing discussion in order to underline what I see as the specific and general consequences of this study. One aim has been to demonstrate the inadequacy of previous accounts which misinterpret Boyle's view of God and nature by being insensitive to the subtlety of the position he embraced. In this regard I hope to have shown that Boyle's view should be understood as a version of concurrentism expressed within the context of the mechanical philosophy. Besides providing a coherent interpretation of his various pronouncements on the relationship between God and nature, an additional virtue of this interpretation is that it explains why his writings have lent themselves to deistic and occasionalist readings. In the very articulation of any concurrentist view there is an unavoidable tendency to lean toward one or the other of the extremes. Aquinas' version, according to which God is the sufficient cause of every natural event, and in which natural entities are conceived of as instruments of divine power, tends dangerously close to occasionalism. Molina's version, according to which there is a pre-established harmony in which God cooperates with a secondary cause by conserving the latter's effect, risks collapsing into deism. The problem of coherently articulating God's relationship to nature is a profoundly difficult one for *philosophical* reasons. It should not be surprising, therefore, that a natural philosopher like Boyle, who laid no claim to be a metaphysician, should express himself in ways which easily lend themselves (in the absence of a careful analysis of the larger context of his writings) to misinterpretation.

There is also a more general conclusion to be drawn. We began by distinguishing two approaches to historiography—"intellectualist" and "social contextualist." Shapin laments that despite the fact that "the central features of the Jacobs' contextualism have been visible in print since 1971, intellectualist studies of corpuscularianism . . . continue to appear which make no reference, even of a critical nature, to their views."[70] Social contextualism *per se* has not been at issue here. I do not dispute that considerations of the sort that Shapin, the Jacobs, and other social contextualists emphasize might well play a role in a complete exposition of Boyle's thought. But another possibility is equally worthy of consideration: that insight can be gained into Boyle's writings on the relationship between God and nature by understanding them as the expression of his attempt to balance various scientific, philosophical, and theologically grounded intellectual commitments. Any logically coherent solution which would avoid the extreme positions of metaphysical deism and occa-

[70] Shapin (1980), 106 n. 31.

sionalism would display the features of the view that Boyle expresses. Too great an emphasis on explanation in terms of social, political, and economic factors is likely to overlook the constraints imposed on the articulation of a philosophy of nature by properly intellectual considerations. It is unlikely that the connection between Boyle's thought and medieval discussions of God and nature could have been discerned without taking seriously the paradigmatically intellectualist task of trying to render his thought coherent. In order to advance further, the historiography of seventeenth century natural philosophy must, it is evident, continue to draw upon intellectualist as well as social contextualist considerations.

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