

THE CONDEMNATION OF 1277, GOD'S ABSOLUTE POWER, AND PHYSICAL THOUGHT IN THE LATE MIDDLE AGES

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by Edward Grant

When Christianity manifested its earliest concern about the physical world, it did so in an atmosphere of fear and hostility toward Greek science and philosophy. Deeply suspicious of these pagan enterprises, the Church Fathers and Christian authors of late antiquity grudgingly came to tolerate them as handmaidens to theology. In time, however, interest in scientific and philosophic thought for their own sake gradually developed. Already evident in the late eleventh century, it is clearly manifested by the prodigious translating activity of the twelfth century, by the close of which the basic intellectual fare for the next four centuries had become available in Latin. In this great storehouse of Greco-Arabic science and learning by far the most significant portion consisted of the works of Aristotle and his commentator, Averroes. Between them they provided a secular world-view complete with principles and modes of demonstration that was not only suitable for comprehending the physical world but also applicable to problems in theology and Holy Scripture. The Aristotelian system of the world was not easily reducible to the status of a theological handmaiden, as abortive attempts to ban and then expurgate the texts of Aristotle in the first half of the thirteenth century at Paris bear witness. By the 1250s, the effort to control the Aristotelian corpus was abandoned and it became firmly entrenched in the universities where it formed the basis of the liberal arts curriculum.

For the first time in the history of Latin Christendom, a conceptually rich and methodologically powerful body of secular learning posed a threat to theology and its traditional interpretations. While many theologians and almost all masters of arts eagerly embraced the new Aristotelian learning, there was a growing uneasiness amongst certain more traditionally minded theologians about the course of events. They feared that Christian theology would be undermined not only by Aristotelian ideas that directly conflicted with the Christian faith, such as the eternity of the world and the unicity of the intellect, but also by modes of thought that were becoming increasingly naturalistic and deterministic. By the 1260s an intensive effort was begun to control the new learning and bring it into conformity with the aims and objectives of traditional theology. This time, however, the weapons employed were not to be the ban or expurgation, but the outright condemnation or restriction of a whole range of ideas deemed dangerous and reprehensible. I am referring here, of

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course to the condemnation of 13 articles in 1270 and of 219 in 1277, the latter condemnation being the basic concern of the discussion to follow.¹

Promulgated 700 years ago, the Condemnation of 1277 was the outcome of doctrinal, philosophical, and personal animosities that rocked Paris in the 1260s and 1270s. It pitted theologians against masters of arts, or philosophers, and theologian against theologian. At issue was the manner in which God's relationship to the world and its physical operations was to be understood. Was the physical world to be interpreted in rigorous conformity with the principles and laws of Aristotelian natural philosophy even where this conflicted with traditional Christian views of the world? The 219 articles condemned by the bishop of Paris, Étienne Tempier, were intended to resolve this dilemma following a request by Pope John XXI to investigate the intellectual unrest which had beset the University of Paris. A diverse collection of 219 propositions that were neither to be held nor defended under pain of excommunication, the Condemnation of 1277 was intended to subvert philosophical necessitarianism and determinism that had become characteristic of philosophical thought in the thirteenth century and that had been derived from Greco-Arabic sources, especially from the works of Aristotle and his ardent admirer and commentator, Averroes.

Inadvertently or not, Aristotelian natural philosophers were thought to have

¹ For the Latin text of the 219 articles presented in their original order, see H. Denifle and E. Chatelain, *Chartularium universitatis Parisiensis* 1 (Paris 1889) 543-555; for a methodical regrouping of the articles aimed at facilitating their use, see Pierre F. Mandonnet, *Siger de Brabant et l'Averroïsme latin au XIII^{me} siècle* ed. 2 rev., pt. 2: Textes inédits (Louvain 1908) 175-191. Using Mandonnet's reorganized version, Ernest L. Fortin and Peter D. O'Neill translated the condemned articles into English in *Medieval Political Philosophy: A Sourcebook*, ed. Ralph Lerner and Muhsin Mahdi (New York 1963) 337-354. Their translation has been reprinted in Arthur Hyman and James J. Walsh, eds., *Philosophy in the Middle Ages: The Christian, Islamic, and Jewish Traditions* (Indianapolis 1973) 540-549. Also following Mandonnet's order is the translation by J. Wellmuth in *Philosophy in the West: Readings in Ancient and Medieval Philosophy*, ed. J. Katz and R. Weingartner (New York 1965) 532-542. For a translation of selected articles deemed relevant to medieval science, see Edward Grant, ed., *A Source Book in Medieval Science* (Cambridge, Mass. 1974) 45-50. Descriptions of the events leading up to, and including, the Condemnation of 1277 appear in Mandonnet, *op. cit.*, pt. 1: Etude critique (Louvain 1911) 214-251, chap. 9, "Condemnation du Péripatétisme 1277"; Fernand Van Steenberghen, *Siger de Brabant d'après ses oeuvres inédites* 2, Les Philosophes belges 13 (Louvain 1942) 357-497, chap. 2, "La Philosophie à l'Université de Paris avant Siger de Brabant"; Pierre Duhem, *Le Système du monde: Histoire des doctrines cosmologiques de Platon à Copernic*, 10 vols. (Paris 1913-1959), pt. 4: "Le Reflux de l'Aristotélisme: Les condamnations de 1277," 6.3-69, and 8.7-120; Gordon Leff, *Paris and Oxford Universities in the Thirteenth and Fourteenth Centuries* (New York 1968) 187-238; and, finally, John F. Wippel, "The Condemnations of 1270 and 1277 at Paris," *Journal of Medieval and Renaissance Studies* 7 (1977) 169-201.

In this 700th anniversary of the Condemnation of 1277, the only major study of its impact on the course of medieval natural philosophy appears in Duhem's *Le Système du monde*. Generally, Duhem subordinated the articles of the condemnation to the larger topics with which he dealt. Moreover, since he tended to treat authors in successive sections, his treatment is fragmented. While Duhem's monumental effort will probably remain the standard for the foreseeable future, my purpose here is to concentrate on the influence of certain articles and to consider only those scholastics who appear to have had, directly or indirectly, one or more of them in mind.

severely restricted God's power by a seeming overreliance on a naturalistic determinism rooted in Aristotle's physical and metaphysical principles. If the condemned articles are an accurate reflection of contemporary opinion, some scholastic natural philosophers were prepared to deny the divine creation of the world, that God could create more than one world, that he could move the world in a straight line leaving behind a void space, that he could create an accident without a subject, and so on. God's power to perform these and other feats that were impossible in the natural world as conceived by Aristotle and his followers was thus denied and severely restricted. It was with all this in mind that the theologians who drew up the condemnation sought to curb the pretensions of Aristotelian natural philosophy by emphasizing the absolute power of God (*potentia Dei absoluta*) to do whatever he pleased short of a logical contradiction.²

Since it touched upon major issues in philosophy and theology, the condemnation was bound to have significant influence and impact. Viewed by some as a necessary antidote to the poison of deterministic, Aristotelian philosophy³ and by others as a dangerous restriction to philosophical and theological inquiry,⁴ the condemnation was generally effective at Paris throughout the fourteenth century,⁵ despite a declaration by the bishop of Paris in 1325 rendering null and void all articles directed

² For Thomas Aquinas's remark that not even God could produce a logical contradiction, see the translation of his *De aeternitate mundi* in *St. Thomas Aquinas, Siger of Brabant, St. Bonaventure, On the Eternity of the World (De aeternitate mundi)*, trans. and introduction by Cyril Vollert et al. (Milwaukee 1964) 22. It was an opinion that was widely accepted.

³ A staunch supporter of the Condemnation, Ramon Lull, in 1298, defended each of the 219 articles in his *Declaratio Raymundi per modum dialogi edita*. For the Latin edition, see Otto Keicher, *Raymundus Lullus und seine Stellung zur arabischen Philosophie, mit einem Anhang, enthaltend die zum ersten Male veröffentlichte "Declaratio Raymundi per modum dialogi edita"*, Beiträge zur Geschichte der Philosophie des Mittelalters 7.4-5 (Münster 1909) 95-221; see also J. N. Hillgarth, *Ramon Lull and Lullism in Fourteenth-Century France* (Oxford 1971) 230-231.

⁴ A bitter opponent was Godfrey of Fontaines, who, sometime around 1296, in a question "Whether the bishop of Paris sins by failing to correct certain articles condemned by his predecessor" ("Utrum episcopus parisiensis peccet in hoc quod omittit corrigere quosdam articulos a praedecessore suo condemnatos"), noted the questionable and contradictory nature of the condemned articles and the grave burdens it laid upon students and masters who fell victim to its uncertainties and confusions. See *Les Quodlibets onze-quatorze de Godefroid de Fontaines (Texte inédit)* ed. J. Hoffmans, *Les Philosophes belges, Textes et études* 5.1-2 (Louvain 1932) 100-105, quodlib. 12 q. 5. For a discussion of this, and Godfrey's seventh quodlibet, question 18, where he considered "Whether a master in theology ought to speak against an article of the bishop if he believes the opposite to be true" ("Utrum magister in theologia debet dicere contra articulum episcopi si credat oppositum esse verum"), see Duhem (n. 1 above) 6.70-76.

⁵ Duhem 6.80. Hillgarth (n. 3 above) 251 claims that "In the decade after Lull's *Declaratio* . . . in the Faculty of Arts the tide was setting more and more against the condemnation of 1277." As evidence, he observes that in the works Lull wrote against the "Averroists" between 1309 and 1311, he "does not appeal to the condemnation and does not refer directly to his *Declaratio*, though he repeats all its arguments." However, since Lull did not abandon the arguments, but indeed repeated them, surely we ought to conclude that the condemnation still exerted a powerful influence on him. Although it is highly probable that the arts masters generally disapproved of the condemnation, it is not likely that they willfully repudiated its separate articles. As we shall see below, Buridan, in the 1340s and '50s, not only upheld them, albeit reluctantly, but occasionally used them to advantage.

specifically against Saint Thomas Aquinas.⁶ Although the legal force of the condemnation was technically confined to the region under control of the bishop of Paris, its influence occasionally spread to England where eminent English scholastics found occasion to cite one or more of the articles as if relevant to, and authoritative in, England.⁷

Scholars in the twentieth century are generally agreed that the Condemnation of 1277 severely reduced the scope and pretensions of philosophy as an independent discipline and that, as the powers of natural reason and experience were circumscribed, reliance on God's omnipotence was increased. In place of the waning Greek naturalism, John Duns Scotus and William Ockham, and their numerous followers, stressed the contingency of God's operations and his omnipotence to do as he pleased short of a logical contradiction.⁸ Thus whatever Aristotle may have demonstrated for the natural world could easily be negated or altered by God's absolute power.

It appears, then, that the major consequence of the Condemnation of 1277 was to manifest and emphasize the absolute power of God, a doctrine that was hardly novel in 1277. After all, God's absolute power to effect whatever he pleased had already been proclaimed by Saint Peter Damian in the eleventh century,⁹ enunciated more effectively in the *Sentences* of Peter Lombard in the twelfth century,¹⁰ and declared unequivocally by Thomas Aquinas in the thirteenth century.¹¹ But why did the doctrine of God's absolute power acquire special significance in 1277 and thereafter? Largely, it would seem, because prior to the thirteenth century there had been no serious internal intellectual threat to Christian theology. With the introduction of Greco-Arabic natural philosophy and metaphysics in the thirteenth century, all this changed, as we have seen. The doctrine of God's absolute power was now invoked in fear and anger by theologians who viewed it as an ultimate defense against the dangerous inroads of pagan thought. Many of the condemned articles forced all to concede that God could do something that had previously been denied him. And if

⁶ See Denifle and Chatelain (n. 1 above) 2 (Paris 1891) 280-281.

⁷ For example, John Duns Scotus and William Ockham (see below).

⁸ Gordon Leff, *The Dissolution of the Medieval Outlook: An Essay on Intellectual and Spiritual Change in the Fourteenth Century* (New York 1976) 28-29, and Étienne Gilson, *History of Christian Philosophy in the Middle Ages* (London 1955) 410.

⁹ See the translation of part of Peter's *De divina omnipotentia* in John F. Wippel and Allan Wolter, O.F.M., eds., *Medieval Philosophy: From St. Augustine to Nicholas of Cusa* (New York 1969) 143-152, esp. 148-149.

¹⁰ Peter declared that "God truly and properly is called an omnipotent trinity because by himself, that is by his natural power, he can accomplish whatever he wishes to do (*quidquid vult fieri*) and whatever he wishes to be able to do (*quidquid vult se posse*) For if, indeed, he wishes something, it happens because nothing can resist his will." My translation (unless otherwise specified, all translations are mine) from *Magistri Petri Lombardi Parisiensis episcopi Sententiae in IV libris distinctae* ed. 3, 1.2 (Grottaferrata 1971) 297-298, bk. 1, dist. 42, chap. 3, par. 6. In the next distinction (bk. 1, dist. 43) par. 1 (p. 298), Peter emphasizes that no restrictions can be placed on God's infinite power. See also Leo Sweeney, S. J., "Divine Infinity: 1150-1250," *The Modern Schoolman* 35 (1957) 42.

¹¹ For example, in his *De aeternitate mundi* (n. 2 above) 20.

that failed to convey the new message, article 147 made it as explicit as possible by condemning the opinion "That the absolutely impossible cannot be done by God or another agent," which is judged "An error, if impossible is understood according to nature."¹²

But it was one thing to concede God's absolute power to perform the naturally impossible any time whatever, and quite another to suppose that he actually performed such impossibilities. For if God chose to exercise his absolute power and execute naturally impossible acts, would he not have violated those very laws of nature which he himself had ordained for a world of his own making? A world subject to such divine alterations would prove unknowable and uncertain. In fact, the medieval world was not conceived as a stage on which an inscrutable, and even capricious, God performed seemingly random acts that made a mockery of lawful regularity. The lawfulness of the cosmos was made compatible with God's absolute power by a distinction originating in the eleventh century between God's *potentia absoluta* and His *potentia ordinata*, or ordained power. The former "referred to the total possibilities *initially* open to God, some of which were realized by creating the established order; the unrealized possibilities are now only hypothetically possible." By contrast, the *potentia ordinata* is restricted "to the complete plan of God for his creation."¹³ From this crucial distinction, it followed that once God had decided the natural order of our world from among the innumerable, initial possibilities, he would not tamper with the plan by substituting from the store of unused possibilities.¹⁴ Thus John Buridan might well have had this significant distinction in mind when he declared that although God could indeed create corporeal spaces and substances beyond the world, and to any degree he pleased, it did not follow that he had actually done so. Therefore, we ought not to assume, for example, that God had created an infinite space beyond the world unless we have independent evidence for so believing, evidence drawn from one or all of the ordinary sources, that is, from the senses, experience, natural reason and the authority of Sacred Scripture.¹⁵

¹²"147. Quod impossibile simpliciter non potest fieri a Deo, vel ab agente alio. — Error, si de impossibili secundum naturam intelligatur"; Denifle and Chatelain (n. 1 above) 1. 552.

¹³See William J. Courtenay, "Nominalism and Late Medieval Religion," in *The Pursuit of Holiness in Late Medieval and Renaissance Religion*, ed. Charles Trinkaus and Heiko A. Oberman (Leiden 1974) 39.

¹⁴*Ibid.* 43. A presumably typical interpretation of the distinction was that of Gabriel Biel (d. 1495). According to Heiko Oberman, *The Harvest of Medieval Theology: Gabriel Biel and Late Medieval Nominalism* (Grand Rapids, Mich. 1967 [1963]) 37, Biel understood the distinction to mean "that God can — and, in fact, has chosen to — do certain things according to the laws which he freely established, that is, *de potentia ordinata*. On the other hand, God can do everything that does not imply contradiction, whether God has decided to do these things [*de potentia ordinata*] or not, as there are many things God can do which he does not want to do. The latter is called God's power *de potentia absoluta*." The brackets are Oberman's. The divine acts discussed in this article are among those that God was thought to have excluded from his ordained plan of creation, but which he was nonetheless capable of enacting by his absolute power.

¹⁵John Buridan, *Questions on De caelo*, bk. 1, q. 17, in Ernest A. Moody, ed., *Quaestiones super libris quattuor De caelo et mundo* (Cambridge, Mass. 1942) 79 lines 1-9.

But if the distinction between God's *potentia absoluta* and *potentia ordinata*, as described above, was generally, and perhaps even universally, accepted in the late Latin Middle Ages, so that few, if any, would have believed that God did, or ever would, actually use his absolute power to alter the natural laws and structure of the world he had created — that is, to perform natural impossibilities¹⁶ — then it follows that the Condemnation of 1277, with its glorification of God's absolute power, could have had virtually no effect on medieval conceptions of the actual operation and structure of the physical world. It merely compelled all to concede that, contrary to the principles of Aristotelian natural philosophy, God could, if he wished, create worlds other than ours, move our world rectilinearly, create an accident without a subject, and do anything else contrary to those accepted principles. But once that concession was made, whether voluntarily or under the duress of possible excommunication, all were free to retain the traditional opinions, as indeed they usually did. Thus it would appear that Alexandre Koyré was right when, in rebuttal of Pierre Duhem's extravagant claims made for the ultimate impact of the Condemnation of 1277,¹⁷ he insisted that the condemned articles relevant to cosmology were of no genuine significance to scientific development because scholastics would have preferred to study the world as it really was rather than be compelled by theological fiat "to study the conditions of possibility of the universes which God could have created had he wished to do so, but which he did not create because he did not wish to do so."¹⁸

Although it may be true that scholastics would have preferred to study the world as it really is — a claim not easily substantiated — Koyré is mistaken when he argues that undue concern with unrealizable possibilities was unproductive and sterile for the history of medieval and early modern science. It will be one of the objectives of

¹⁶ If at some future time, a natural impossibility should actually occur, medieval theologians would have interpreted it as part of God's ordained plan (*potentia ordinata*). It is this ordained power which is at issue in an interesting discussion by the seventeenth-century Jesuit, Bartholomaeus Amicus, who allowed that, although vacuum was contrary to universal order, God could act against that order and introduce a vacuum. Amicus believed that, because of divine goodness, God could not diverge from all order and introduce total disorder into the world; but there was nothing to prevent him from substituting for one system of natural order which prevented the formation and existence of vacua, another which allowed the formation and existence of vacua. These were not incompatible acts, since God did not exhaust his creative possibilities in this present world. Thus to introduce vacua into our world would be compatible with his creative power and plan, although it would be contrary to the present customary course of nature; Bartholomaeus Amicus, *In Aristotelis libros De physico auditu dilucida textus explicatio et disputationes* . . . , 2 vols. (Naples 1626-1629) 2.746E and 747B-C, bk. 4, q. 2, dub. 3. If, however, God had not ordained the introduction of vacua into our world, the possibility of so doing would, according to medieval conceptions, belong to his absolute power (*potentia absoluta*).

¹⁷ In Pierre Duhem, *Études sur Léonard de Vinci, ceux qu'il a lus et ceux qui l'ont lu*, 3 vols. (Paris 1906-1913; repr. 1955) 2.412, Duhem attributed the birth of modern science to the influence of articles 34 and 49, which will be discussed below. For a translation of the passage, see Edward Grant, "Late Medieval Thought, Copernicus, and the Scientific Revolution," *Journal of the History of Ideas* 23 (1962) 200 n. 8. Duhem moderated his opinion (n. 1 above) 8.7-8.

¹⁸ Alexandre Koyré, "Le vide et l'espace infini au XIV^e siècle," *Archives d'histoire doctrinale et littéraire du moyen âge* 24 (1949) 51. See also Grant (n. 17 above) 200 n.9.

this paper to counter Koyré's claim as one aspect of a broader purpose which seeks to demonstrate the powerful impact of, and preoccupation with, God's absolute power not only as it was manifested in specific articles of the condemnation, but also, more generally, in its capacity as a powerful analytic tool in natural philosophy. The latter role, as we shall see, was as much a part of the history of the overall influence of the Condemnation of 1277 as are the specific articles with which we shall be concerned.

Despite the exaggerated and indefensible character of Pierre Duhem's claim that the Condemnation of 1277 was "the birth of modern science," he was right to emphasize the special significance of two articles, 34, which made it mandatory to concede that God could make more than one world, and 49, which compelled assent to the claim that God could move the heavens, or world, with a rectilinear motion even though such motion might leave behind a vacuum. Since these two articles struck at fundamental ideas in Aristotelian natural philosophy, it is appropriate to commence our study with them, turning first to article 34 and the possibility of a plurality of worlds.¹⁹

Sometime between 1230 and 1235, and long before 1277, the most significant

¹⁹In dealing with the influence of the Condemnation of 1277, we must ask whether it is reasonable and plausible to assume that most, if not all, instances where God's absolute power is made the basis of a physical argument are also instances of the influence of the Condemnation of 1277. At the risk of being accused of arguing "post hoc, ergo propter hoc," I have assumed an affirmative response, since it was only after 1277, and because of the condemnation, that the principle of God's absolute power came to be used widely in the analysis and discussion of numerous physical problems involving both corporeal and spiritual entities.

In determining the influence of specific articles on the subsequent course of natural philosophy, it is obviously important to ascertain whether a particular article is actually intended. Where the phrase "article condemned at Paris" appears, we can be reasonably certain that it was among those condemned in 1277. More often, however, the substance of an article is given without any mention of its condemnation, as when, for example, William Ockham declared that the divine power could locate several bodies in the same place ("Ad tertium dico quod sic quia plura corpora possunt esse in eodem loco per potentiam divinam . . ."; William Ockham, *Quotlibeta septem; Tractatus de sacramento altaris* [Strasbourg 1491; repr. in facs. Louvain 1962], quotlib. 1, q. 4, sig. a4v, col. 1 [the folios are unnumbered]). Since, elsewhere in the same work, Ockham mentions specific articles "condemned at Paris," and therefore indicates an awareness of the Condemnation of 1277, it would appear reasonable to suppose that he had in mind article 141, which declared it an error to claim that God could not make several bodies exist simultaneously in the same place (Denifle and Chatelain [n. 1 above] 1. 551). Judgments of this kind must frequently be made and will play a role in what follows.

Ideally, any assessment of the impact of the Condemnation of 1277, and its intimately associated notion of the absolute power of God, on the course of medieval natural philosophy should rest on evidence gathered by a thorough study of the whole range of relevant scholastic literature. Only on such empirical foundations can we arrive at a definitive and conclusive evaluation of the impact of the condemnation as a whole and of each of its numerous articles. Since inspection of the whole mass of medieval scholastic literature is obviously impractical and unfeasible, the evidence gathered here is the byproduct of my own research interests on the concepts of place, space, and vacuum, and cosmology in general. Although it is very likely that many other specific citations and unspecified allusions to relevant articles of the condemnation lie as yet undetected in the largely unstudied mass of scholastic literature, those that have thus far come to light will be used to serve the objectives of this paper.

arguments against the existence of a plurality of worlds had already been clearly formulated in a commentary on the *Sphere* of Sacrobosco ascribed to Michael Scot.²⁰ One of the most widely used arguments involved void space.²¹ For if several worlds existed, they would exist either in one place or in different places. Since it was axiomatic that two or more bodies could not exist naturally in the same place simultaneously, it followed that they must exist in different places, which implied the existence of intervening space, a condition that would obtain even if two of the worlds were in contact at a single point. Now either this intervening space is filled with body or it is void. But no body can exist there since it would belong to none of the worlds around it. Nor indeed could the space be void, since Aristotle had demonstrated the impossibility of void space in the fourth book of the *Physics*.²²

Michael Scot drew his second fundamental argument against a plurality of worlds from the first book of Aristotle's *De caelo*,²³ where Aristotle argues that if other worlds existed, their elements, and the motions of those elements, would be identical with those in our world. With identical natures, Aristotle insisted that all these elements in the different worlds could have only one center and circumference. But if there is only one center and circumference for all elements and things, there can only be one, unique world, for if many centers and circumferences existed, many worlds would exist, a world for each center and circumference. Indeed, if many worlds existed each with identical elements possessed of the same natural motions and, furthermore, if each world had its own center and circumference, particles of earth from our world would tend to move toward the center of another world and thus rise with a violent, or unnatural, motion toward the circumference of our world; particles of earth in other worlds would behave similarly. The same reasoning would, of course, apply to the element fire. Both earth and fire would thus be capable of rising and falling "naturally," even though an element could only have one natural motion, either up or down. Since a plurality of worlds would obviously play havoc with Aristotelian physics and cosmology, the possibility was rejected by Michael Scot and others.²⁴

²⁰ Edited by Lynn Thorndike, *The "Sphere" of Sacrobosco and Its Commentators* (Chicago 1949) 247-342. For the dates, see 48. The most extensive discussion on the problem of a plurality of worlds is by Duhem (n. 17 above) 2.57-96, 408-423, and (n. 1 above) 9.363-430. For a recent summary and evaluation of medieval views, see Steven J. Dick, "Plurality of Worlds and Natural Philosophy: An Historical Study of the Origins of Belief in Other Worlds and Extra-terrestrial Life," Ph.D. diss. (Indiana University 1977) 71-108. Of the two basic types of plurality frequently discussed — i.e., successive or simultaneous worlds (see Buridan's distinction in his *Questions on De caelo*, bk. 1, q. 19 [n. 15 above] 88) — we shall focus on the latter.

²¹ All the arguments cited here from Michael Scot's commentary on the *Sphere* of Sacrobosco occur on pp. 252-254 of Thorndike's edition.

²² Sometime between 1231 and 1236, when Michael Scot wrote his commentary on the *Sphere* of Sacrobosco, William of Auvergne repeated much the same argument against a plurality of worlds, as did Roger Bacon decades later. See William of Auvergne, . . . *Opera omnia*, 2 vols. (Paris 1674; repr. in facs. Frankfurt a.M. 1963) 1. 607-608, *De universo*, first part of pt. 1, chaps. 13-14, and Roger Bacon, *Opus majus*, trans. Robert B. Burke, 2 vols. (Philadelphia 1928) 1. 186.

²³ For Aristotle's arguments against a plurality of worlds, see *De caelo* bk. 1, chaps. 8, 9.

²⁴ Aquinas also found this a compelling argument. See Thomas Aquinas, *In Aristotelis libros De caelo et mundo; De generatione et corruptione; Meteorologicorum expositio*, ed. Ray-

Despite these powerful physical arguments, however, Michael acknowledges that some believed it possible for an omnipotent God to make other worlds, even an infinite number of them, and to create them from identical or different elements indifferently.²⁵

In response, Michael readily assents that by his absolute power God could, if he wished, create a plurality of worlds. But although God has the power to create many worlds, nature itself, as a caused entity, is incapable of receiving them, since it has not been endowed with a capacity to receive many worlds simultaneously.²⁶ Like Michael Scot before him, Thomas Aquinas also acknowledged that, by his absolute power, God could create other worlds.²⁷ But Aquinas insisted that the best and most noble ends would not be served by many worlds. For if these other worlds were similar to ours, they would be superfluous; and if dissimilar, none would be perfect, since none could incorporate within itself the totality of natures of sensible bodies. Under these conditions, it would require a combination of all the separate worlds to make a perfect world, a state of affairs that could be achieved by a single world. It is better, therefore, to make a single, perfect world than many that are imperfect and better also to assign goodness to a single world than to diminish that goodness by division. For Aquinas, "those can posit many worlds who do not assume any guiding wisdom as the cause of the world, but [rather] chance, as Democritus, who said that this world, and the infinite number of other worlds, was made from a [chance] concurrence of atoms."²⁸

With the promulgation of the Condemnation of 1277 and article 34, which condemned those who believed that God could not create more than one world,²⁹ the content and character of the arguments changed drastically. Although all at Paris were compelled to acknowledge that God could create other worlds if he wished,

mond M. Spiazzi, O. P. (Turin 1952) 80, *Expositio in Aristotelis libros De caelo et mundo* bk. 1, lect. 16.

²⁵"Et dicendum, et quidam dicunt, quod deus potuit et potest ita cum isto mundo alium et alios facere vel etiam infinitos cum sit omnipotens, et hoc ex elementis eiusdem speciei et nature vel etiam diverse"; Thorndike (n. 20 above) 253. Since the authors embraced by the term "quidam" are not identified, we cannot assess the importance of Michael Scot's dramatic remark. Prior to 1277, however, their importance could only have been minimal and the content of their discussions meager.

²⁶*Ibid.* 253-254. In his *De universo*, William of Auvergne similarly denied a plurality of worlds and attributed this to a deficiency on the part of the other potential worlds rather than to God; (n. 22 above) 1.611, *De universo*, first part of pt. 1, chap. 16. Duhem argues that in opposing to God's creative power an already determined nature, Michael Scot reveals acceptance of the God of Averroes rather than the God of the Christians (n. 1 above) 9. 365. Prior to 1277, Parisian masters, according to Duhem (380), denied God the power to create a plurality of worlds and then argued that this was not a limitation on his creative powers. Michael Scot and William of Auvergne seem to fit this pattern, since they allow that God has the power to create other worlds, but somehow these other potential worlds cannot be realized because of nature's inherent deficiencies.

²⁷Aquinas (n. 24 above) 94-95, *De caelo et mundo* bk. 1, lect. 19.

²⁸For the Latin text, see Thomas Aquinas, *Summa theologiae* (Ottawa 1941) vol. 1, pt. 1, q. 47, art. 3 ("Utrum sit unus mundus tantum"); also see Dick (n. 20 above) 80-81.

²⁹"34. Quod prima causa non posset plures mundos facere"; Denifle and Chatelain (n. 1 above) 1. 545.

their reactions fall into two broad categories. There were those who, while forced to acknowledge God's absolute power to create as many worlds as he wished, found even the possibility of a plurality of worlds physically untenable and invoked arguments that were intended to show that it was naturally impossible. For this group, among whom John of Jandun is perhaps the most significant representative,³⁰ Aristotle's arguments remained in force and all attempts to accommodate physics and cosmology to the possible existence of other worlds were avoided or refuted.

But there were those who took seriously the possibility that God could create other worlds than our own and, on the assumption that he did create them, sought to counter those of Aristotle's arguments that had previously been accepted more or less routinely. It is from among this group of scholastics³¹ that the impact and significance of article 34 is revealed. For despite an almost unanimous conviction that God had not actually created other worlds,³² they formulated arguments that sought to make the possible existence of other worlds intelligible.

Let us consider first the kinds of responses that were made to the Aristotelian claim that formally identical elements in the separate worlds would move to a single center and circumference, thus producing, as we saw above, the absurd consequence that a particle of earth would move naturally up in one world and naturally down in another and thereby violate Aristotle's fundamental principle that an element can possess only one natural motion. The basic response, on which numerous elaborations would be made, was already formulated by Richard of Middleton sometime around 1300. In commenting on book 1, distinction 44 of Peter Lombard's *Sentences*, which was concerned with the problem of whether God could make something better than he had made it, a problem that frequently prompted discussion of a plurality of worlds, Richard maintained that even if all the worlds that God might create were identical, as Aristotle had assumed, it would not follow that the earth and any of its parts would have a natural inclination to move upward in one world toward the center of another. Indeed, each earth would remain at rest in the center of its own world and any parts of it that might be removed would, if unimpeded, always tend to return to the whole of it at the center. Moreover, if it were possible to remove the earth of another world and place it at the center of ours,

³⁰ For Jandun, see Duhem (n. 1 above) 9.387-389.

³¹ The group includes Godfrey of Fontaines, Richard of Middleton, Ramon Lull, Johannes Bassolis, William Ockham, Walter Burley, Robert Holkot, William of Ware, Gaetanus de Thienis, Nicole Oresme, and Thomas of Strasbourg. As we see below, while John Buridan and Albert of Saxony accepted as plausible one of the major departures from Aristotle and both conceded the supernatural possibility of a plurality of worlds, they rejected most, if not all, of the other alternatives to Aristotle's defense of a single world.

³² John Major seems an extraordinary exception. In his *Propositum de infinito*, published in 1506, he first brought the question of a plurality of worlds to a stalemate, arguing that, "naturally speaking" (*naturaliter loquendo*) one could no more prove the existence of a unique world than the existence of an infinite number, as Democritus would have it. But he went on to proclaim that "I believe, as the master Democritus thought, that there are an infinite number of excentric and perhaps concentric worlds." See Dick (n. 20 above) 100; the translation is Dick's. Major's discussion appears in *Le Traité "De l'infini" de Jean Major*, ed. and trans. Hubert Elie (Paris 1938) 60-62; see also 56-58, and 114.

that earth would remain at rest in the center of our world; and, conversely, if our earth were removed to the center of another world, it would remain at rest there with no inclination to move toward its former place. All this, Richard concludes, is also “the opinion of Lord Stephen, bishop of Paris and doctor of sacred theology, who excommunicated those who dogmatized that God cannot make more worlds.”³³ Contrary to Aristotle, Richard of Middleton, and many others subsequently, conceived each world as a self-contained, closed system having its own proper center and circumference. It followed that if God should create more than one world, no unique and privileged center could exist.

During the fourteenth century, further elaborations and refinements were made. William Ockham, for example, in commenting on the same distinction of the *Sentences*, derived the possibility of other worlds from God’s ability to produce “an infinite number of individuals of the same species as those which now exist.” Since “He is not limited to producing them in this world, therefore He could produce them outside this world and make a world of them just as He made this world from those things which he produced here now.”³⁴ In each possible world that God could create to contain some, or all, of these additional individuals, elements such as fire and earth would move only within their own worlds. Their behavior would be analogous to that of two fires, one moving toward the circumference of the heaven over Oxford, the other moving toward heaven over Paris. If these masses of fire were switched, the fire now over Paris, but formerly over Oxford, would move directly upward toward the part of the celestial circumference over Paris, with no inclination to move back over Oxford.³⁵

In his *Questions on De caelo*, John Buridan characterized as “non-demonstrative” Aristotle’s defense of the claim that heavy bodies in other worlds would move toward the center of ours. This would be true, countered Buridan, only if the inclinations of heavy bodies depended solely on their common tendency to move toward a single center. But motions are also dependent on celestial bodies and God. Since every world would have its own celestial bodies and God’s presence and control would be equal in all, the heavy earthy bodies of a particular world would fall only to the center of their own world.³⁶

³³ Richard of Middleton, *Super quatuor libros sententiarum Petri Lombardi Quaestiones subtilissimae*, 4 vols. (Brescia 1591; repr. Frankfurt a.M. 1963) 1.392 col. 2 (bk. 1, dist. 44, art. 1, q. 4: “Utrum Deus posset facere aliud universum”). Although he makes no mention of article 34, Thomas of Strasbourg repeated and approved much the same argument, adding only that each earth would rest in its own world naturally, not violently. God’s absolute power must not, he insisted, be limited by sophisms and Aristotelian arguments. See Thomas of Strasbourg, . . . *Commentaria in IIII libros sententiarum* (Venice 1564; repr. 1965 by the Gregg Press, Ridge-wood, N.J.) fols. 117v-118r, bk. 1, dist. 44, art. 4; and also Duhem (n. 1 above) 9.385-387.

³⁴ Translation by Dick (n. 20 above) 91, from William Ockham, *Opera plurima*, 4 vols. (Lyons 1494-1496; repr. in facs. London 1962), vol. 3: *Super 4 libros sententiarum*, bk. 1, dist. 44, sig. bbv, verso (E) (unfoliated).

³⁵ Dick 92 and Ockham (F).

³⁶ See Buridan (n. 15 above) 86-87, bk. 1, q. 18. In qq. 18 and 19, where he considered a plurality of worlds, Buridan emphasized that God could, if he wished, create other worlds, both similar and dissimilar. Indeed, in an obvious reference to article 34 of the condemnation, Buridan

A significant departure from Aristotelian cosmology that emerged from the assumption of a plurality of worlds was formulated by Nicole Oresme in a French commentary on Aristotle's *De caelo* written in 1377. Here, in denying the movement of heavy bodies to a unique center,³⁷ Oresme redefined the meanings of "up" and "down" in terms of their relationships to "light" and "heavy" respectively. Abandoning Aristotle's absolute sense of up, down, light and heavy, Oresme argued that a body is to be judged "heavy," and may be said to be "down," when it is surrounded by light bodies, where the surrounding "light" bodies are said to be "up." Thus heavy and light, with the associated, and interrelated, concepts of down and up, could be conceived independently of the natural places of bodies,³⁸ as Oresme illustrates by reference to an earlier example in which this independence of natural place was graphically demonstrated. After imagining that a tile, or copper, pipe extends from the center of the earth to the heavens, presumably the concave surface of the lunar sphere, Oresme argues that "if this tile were filled with fire except for a small amount of air at the very top, this air would drop down to the center of the earth for the reason that the less light body always descends beneath the lighter body. And if this tile were full of water save for a small quantity of air near the center of the earth, this air would mount up to the heavens, because by nature air always moves upward in water."³⁹ In this context, earth is heavy and down because

asserts that "we hold on faith that just as God made this world, so could he also make another, or others" (84; see also 89 for the same sentiment). Although compelled to concede God's power to create other worlds, Buridan preferred to believe that if God wished to create additional creatures such as appear in our world, he would simply enlarge our world to double, or one hundred times, its present size. See Buridan, *Questions on the Physics*, bk. 3, q. 15, in John Buridan, *Questiones super octo Phisicorum libros Aristotelis diligenter recognite et revise magistro Johanne Dullaert de Gandavo* (Paris 1509; repr. in facs. under the title *Johannes Buridanus, Kommentar zur Aristotelischen Physik*, Frankfurt a.M. 1964) fol. 57v col. 2.

In a similar manner, Albert of Saxony, like Buridan only a master of arts and not a theologian, conceded that supernaturally many worlds were possible, whether simultaneous or successive, eccentric or concentric. He also supported the opinion that if other worlds like ours existed, the earth of each would remain naturally at rest. But he too refused to believe that any such worlds could exist naturally beyond ours. See his *Questions on De caelo*, bk. 1, q. 11 ("Utrum sint vel possint esse plures mundi") in *Questiones et decisiones physicales . . . Alberti de Saxonia in octo libros Phisicorum; tres libros De celo et mundo . . . recognitae . . . Georgii Lokert Scotia* (Paris 1518) fol. 95 col. 2.

³⁷Nicole Oresme: *Le Livre du ciel et du monde*, ed. Albert D. Menut and Alexander J. Denomy, trans. Menut (Madison 1968) 174,175.

³⁸After distinguishing two senses of "up" and "down" (one with regard to us, as when we say that half the heavens lie up, above us, and the other half down, below us; and the other used with respect to heavy and light bodies, the latter sense being Oresme's sole concern here), Oresme declares that "up and down in this second usage indicate nothing more than the natural law concerning heavy and light bodies, which is that all the heavy bodies so far as possible are located in the middle of the light bodies without setting up for them any other motionless or natural place"; *ibid.* 173.

³⁹*Ibid.* 71. Although Oresme makes certain qualifications where he first formulates this illustration, they seem not to apply in the context of our discussion where the example is intended only to show "how a portion of air could rise up naturally from the center of the earth to the heavens and could descend naturally from the heavens to the center of the earth" (*ibid.* 173).

it comes to rest naturally in the center of the lighter bodies that surround it. From this Oresme infers further that if an earthy, or heavy, body were not surrounded by lighter bodies, that heavy body could not be said to be up or down, from which he concludes that if a vacuum existed between our world and any other, a particle of earth from that world could not possibly move to the center of ours. For even if it could rise up and depart beyond the circumference of its own world, it would enter the void between worlds and come to rest, since lighter bodies would no longer surround it and all directionality would have vanished. Thus did Oresme conclude that "if God in his infinite power created a portion of earth and set it in the heavens where the stars are or beyond the heavens, this earth would have no tendency whatsoever to be moved toward the center of our world."⁴⁰

Thus did Nicole Oresme propose a new explanation of directionality which was utterly opposed to Aristotle's. Despite a conviction that "there never has been nor will there be more than one corporeal world,"⁴¹ Oresme was ultimately motivated by article 34 of the Condemnation of 1277, which he reiterated when he declared that "God can and could in his omnipotence make another world besides this one or several like or unlike it."⁴²

In turning to the second major argument against a plurality of worlds, namely the presumed impossibility of void space between distinct and simultaneously existing worlds, we find that in his discussion, Oresme simply assumed the existence of intercosmic void space. Prior to 1277, as we have already seen, discussants of the plurality of worlds question, such as Michael Scot, William of Auvergne, and Roger Bacon, had rejected the existence of other worlds by virtue of their conviction that intervening void space was a necessary consequence of plurality. After all, Aristotle had shown in the fourth book of his *Physics* that void space was impossible; therefore, they concluded that it could no more exist beyond the world than within.⁴³

With the proclamation of article 34, however, not only was it necessary to admit the possibility that God could create other worlds, but that very admission, coupled with Aristotle's definition of vacuum as a place deprived of body but capable of receiving body,⁴⁴ implied the existence of something beyond the world, either body

⁴⁰*Ibid.* 173. Since the ethereal substance of stars was conceived as neither light nor heavy and offered no resistance to bodies, Oresme could equate stars and void. It is of interest that Oresme cites Aristotle's conclusion that in a vacuum there is no up or down so that a heavy body could not move itself in a vacuum. For Aristotle, however, the lack of directionality in a vacuum was a direct consequence of its homogeneity, whereas for Oresme it resulted from the absence of surrounding light bodies.

⁴¹*Ibid.* 179.

⁴²*Ibid.* 177-179.

⁴³Although not cited in the pre-1277 arguments we have described here, Aristotle had also denied that body or void could exist beyond the world (*De caelo* 1.9.279a.12-18).

⁴⁴For this definition, see Aristotle, *De caelo*, 1.9.279a.14-15. In *Physics* 4.1.208b.25, 4.7.213b.32, and 4.8.214b.18-19, Aristotle defines vacuum simply as a place without a body. As Dick observes (n. 20 above) 76-77, Aristotle did not use the possible existence of intercosmic

or void. If body existed where God might create a world, it would follow that upon creation of a world there, two bodies would coexist simultaneously in the same place, a natural, but not a supernatural, impossibility. In this alternative, one had only to invoke article 141 of the Condemnation of 1277, which made it necessary to concede that God could create several dimensions, or bodies, in the same place simultaneously.⁴⁵ Should the region beyond our world be devoid of body, then the mere possibility that a world, or body, could be created there implied, by Aristotle's very definition, that a void space existed there.

Robert Holkot appears to have seen these implications clearly, although he makes no reference to condemned articles. In a significant argument, he declared that if God could make another world, he could create it anywhere. Holkot then inquires whether there is anything now in the place where God could create that world. If there is, it must be something, presumably a body, or nothing. If something exists there, then a body exists beyond the world. If nothing, then Holkot argues as follows: "Beyond the world nothing exists; but beyond the world a body can exist [since God can create a world there]; therefore a vacuum exists beyond the world because a vacuum exists where a body can exist, but does not. Therefore a vacuum is there now."⁴⁶ For Holkot, the existence of a body or void beyond the world was not merely hypothetical, but real. The mere possibility that God could create another world, as required by article 34, enabled him to infer these significant alternatives, one of which must be true, with extracosmic void as the more likely candidate. Perhaps it is a measure of the degree to which opinions and attitudes had changed since the thirteenth century that Walter Burley could declare that Christian theologians, and those generally who believed in the creation of the world, could hardly avoid the conclusion that a vacuum existed beyond our world since they also conceded that God could create another world.⁴⁷

void space as an argument against a plurality of worlds. Such an argument would have been circular, since "one of the proofs of the nonexistence of void was that there could be no body outside the world."

⁴⁵For the text and translation of article 141, see below.

⁴⁶Because of its importance, I cite the whole of Holkot's brief argument: "Praeterea, si Deus posset modo facere alium mundum ab isto, posset facere illum esse alicubi, sicut iste est modo, ita quod partes illius mundi distarent abinvicem extra mundum istum. Quero ergo quid est ibi modo: an aliquid an nihil. Si aliquid, ergo extra mundum de facto est aliquid. Si nihil, tunc arguitur sic: extra mundum nihil est, et extra mundum potest esse corpus; ergo extra mundum est vacuum, quia ubi potest esse corpus, et nullum est, ibi vacuum est. Ergo vacuum modo est"; Robert Holkot, *In quatuor libros sententiarum Quaestiones* (Lyon 1518; repr. in facs. Frankfurt a.M. 1967), bk. 2 q. 2, sig.bii, recto, col. 2 (no foliation).

⁴⁷"Difficile tamen ut mihi videtur est vitare quin loquentes nostre legis et generantes mundum habeant ponere vacuum extra mundum quia ipsi dicunt quod sicut Deus creavit hunc mundum ita posset creare alium mundum"; Walter Burley, *Super octo libros Phisicorum* (Venice 1501; repr. in facs. with the title *In Phisicam Aristotelis Expositio et quaestiones* [Hildesheim 1972]), fol. 89r, col. 1. Burley indicates that he will consider the problem of extracosmic void further in his commentary on Aristotle's first book of *De caelo*, which I have not seen. It is perhaps worth reporting that, in the fifteenth century, Gaietanus (or Caietanus) de Thienis, who summarized Burley's opinion and mentioned the latter by name, denied that Christians must concede a vacuum beyond the world ("nec oportet Christianos concedere vacuum extra celum").

In the context of a discussion on a supernaturally created plurality of worlds, Nicole Oresme would also proclaim the reality of extracosmic void space, when he insisted that “the human mind consents naturally, as it were, to the idea that beyond the heavens and outside the world, which is not infinite, there exists some space whatever it may be, and we cannot easily conceive the contrary.”⁴⁸

When it was realized that an extracosmic void space was a plausible consequence of a plurality of supernaturally created worlds, inquiries were made as to its nature. Was it possible, for example, to measure distances in such a space?⁴⁹ If a body were located beyond our world, could its distance to the convex surface of the outermost sphere of our world be measured? Reared in an intellectual tradition in which distances were always measured over intervening material dimensions, which characterized the Aristotelian plenum of our cosmos, most scholastics denied the possibility of measurements in empty space. For them, a stone located anywhere beyond the world in a void space would immediately come into contact with the outermost convex surface of our world. Only if God created intervening bodies, insisted Marsilius of Inghen, could the stone lie at a measurable distance from that surface. Indeed even those other worlds would come into contact at a single point with our world and with others.

But efforts were made to confer intelligibility on a sense of measurement in void space. Henry of Ghent, for example, assumed extracosmic vacuum to be three dimensional and therefore able to function as if it were an intervening body in a plenum. Jean de Ripa⁵⁰ utilized a series of paradoxes to demonstrate that if the matter between two bodies was destroyed, the distance previously separating them would remain the same even in the imaginary space, or vacuum, which now separated them.⁵¹ And, finally, William of Ware (Guilelmus Varonis) insisted that God could create two distinct, spherical worlds with an intervening distance, just as one part of a heaven in our world is separated from part of another heaven also in our world. Indeed, William assumes that prior to the creation of our world absolutely nothing

See Gaietanus, *Recollecte . . . super octo libros Physicorum cum annotationibus textuum* (Venice 1496), bk. 4, fol. 28v, col. 2. Even before Gaietanus, Albert of Saxony refused to concede that any space or vacuum existed beyond the world even though he admitted that God could create other worlds (see his *Questions on De caelo*, bk. 1, q. 9 [n. 36 above] fol. 93v, col. 2).

⁴⁸Oresme (n. 37 above) 177. Although, as Oresme explains, “we cannot comprehend nor conceive this incorporeal space which exists beyond the heavens,” its existence is confirmed by reason and truth (“rayson et verite nous fait congnoistre que elle est”).

⁴⁹For a fuller discussion and references, see Edward Grant, “Place and Space in Medieval Physical Thought,” in *Motion and Time, Space and Matter, Interrelations in the History of Philosophy and Science*, ed. Peter K. Machamer and Robert G. Turnbull (Columbus 1976) 147-148, 151-152; also see n. 128 below.

⁵⁰On Henry of Ghent and Jean de Ripa, see *ibid.*

⁵¹Gaietanus de Thienis denied that two worlds could be materially distant from each other – that is, have a body between them (no body exists there) – or that they could be separated by a vacuum, the existence of which he denied. But they could be separated formally (*formaliter*). His opinion was in reaction to that of Walter Burley, who, according to Gaietanus, believed that two distinct worlds would indeed be separated by a divisible void space receptive of body, but in which there was no body. See Gaietanus (n. 47 above) fol. 28v, col. 2.

existed, a situation which could be imagined as an infinite space with nothing in it. Within that infinite space, God created our world and could add as many more as he pleases, even to infinity.⁵²

Thus it was that the absolute power of God to make as many worlds as he pleased raised physical problems that evoked interesting solutions most of which conflicted with, or were alien to, the principles of Aristotelian physics and cosmology, or involved the adaptation of an Aristotelian principle, or principles, to situations and conditions which Aristotle had never seriously contemplated and which he would probably have considered absurd.

Article 49 produced an even greater range of interesting responses relevant to the history of medieval physical thought. The contexts of the subsequent discussions of article 49 – that is, discussions in which God is assumed to move the outermost sphere of the heaven (*ultimum celum*), or the world itself (*mundus*)⁵³ – indicate that as many as four major reasons may have induced the bishop of Paris to condemn it. Two of these are mentioned by Richard of Middleton in the second book of his commentary on the *Sentences*, written only eight or nine years after issuance of the condemnation.⁵⁴

In considering the question “whether God could move the last heaven rectilinearly,” Richard presents two arguments as to why God could not do this, arguments that were perhaps standard responses prior to 1277. The first of these concerns the Aristotelian principle that every rectilinear motion is necessarily from place to place. Since Aristotle had shown that the last heaven of the world is not in a place and had further claimed that no body, and therefore no place, could exist beyond the world, it followed that without a place to depart from and a place to arrive at, not even God could move the last heaven, or world, rectilinearly.⁵⁵ The

⁵² Duhem (n. 1 above) 9.381-382. Duhem’s discussion and French translations of William of Ware’s ideas are based on the latter’s commentary on the *Sentences*, bk. 2, q. 8 (“Quaeritur utrum Deus posset facere alium mundum simul cum isto”).

⁵³ The text of article 49 states: “Quod Deus non possit movere celum motu recto. Et ratio est, quia tunc relinqueret vacuum”; Denifle and Chatelain (n. 1 above) 1.546. Although, as will be seen below, Richard of Middleton interpreted “celum” as “heaven,” and assumed that the outermost sphere was intended, the term “celum” was also taken to represent the world, or “mundus.” Indeed, the latter term was often substituted for “celum,” as when Buridan, in a specific reference to the error condemned by the bishop of Paris, declared: “Sed de potentia divina determinatum fuit per episcopum Parisiensem et per studium Parisiense, quod error esset dicere quod Deus non posset movere totum mundum simul motu recto”; (n. 15 above) 75, bk. 1, q. 16. Nicole Oresme (see below), and many others, would make the same substitution.

⁵⁴ A. B. Emden, *A Biographical Register of the University of Oxford to A.D. 1500*, 3 vols. (Oxford 1957-1959) 2.1254, dates the composition of the second book of Richard’s *Sentences* commentary between 1285 and 1286. Richard studied at the University of Paris, but whether he was French or English is uncertain (pp. 1253-1254).

⁵⁵ Richard explains that God cannot move the world “quia omnis motus corporis rectus est de loco ad locum. Sed secundum Philosophum 4. *Physicorum* ultimum celum non est in loco; secundum etiam eundem primo *Caeli et Mundi*, extra ultimum celum non est locus, neque plenitudo, neque vacuitas. Ergo impossibile est Deum movere ultimum caelum motu recto”; Richard of Middleton (n. 33 above) 2.186 col. 1, bk. 2, dist. 14, art. 3, q. 3 (“Utrum Deus posset movere ultimum caelum motu recto”).

second argument, since it conforms to the literal sense of the text, was perhaps the most important reason for the condemnation of article 49. It denied to God the ability to move the world with a rectilinear motion because a vacuum would be left behind, which clearly implied that although God might possess the power to move the world with a translatory motion, he would be prevented from doing so by nature's abhorrence of a vacuum, which Aristotle had demonstrated in a variety of ways. Therefore, the world must of necessity remain where it is to prevent formation of the dreaded vacuum, which not even God could create.⁵⁶

A third relevant reason for the condemnation of article 49 may have derived from Averroes, who argued that the existence of an absolutely motionless body was a necessary precondition for motion. As an immobile body incapable of translatory motion, the world itself served this essential function, a situation which, presumably, not even God could alter. To counter this restriction of God's absolute power, and deprive the Averroists of their absolutely immobile body, the bishop of Paris and his theologians forced the concession that God could, if he wished, move the last heaven, or world, rectilinearly.⁵⁷

Thomas Bradwardine, in a work of 1344, suggests yet a fourth reason when he explained that those who follow Aristotle's arguments in the first book of *De caelo* "assume that every local motion is necessarily upward, downward, or circular — that is, away from the center [of the world], toward the center, or around the center." Since the rectilinear motion of the world qualifies as none of these, "they say that it is impossible for the world to be moved."⁵⁸

Compelled after 1277 to concede that God could move the last heaven, or whole world, rectilinearly, scholastics had to reformulate their responses to the arguments described above and devise new interpretations to meet the altered circumstances. How this was done, we must now describe.

In the aftermath of the condemnation, scholastics had to determine how it was possible for a material entity like the last heaven, or the world itself, to be moved rectilinearly without occupying successive places. Aristotle had defined the place of a body as "the [innermost] boundary [or surface] of the containing body at which it is in contact with the contained body."⁵⁹ Since Aristotle's cosmos is a material

⁵⁶ "Item Deus non posset facere vacuum Sed si Deus posset movere celum ultimum motu recto posset facere vacuum, quia si moveretur motu recto, aliqua pars eius recederet a loco in quo est; nec succederet in illum locum aliud corpus. Ergo Deus non posset ultimum celum movere motu recto"; *ibid.*

⁵⁷ This plausible reason was presented, without supporting evidence, by Max Jammer, *Concepts of Space: The History of Theories of Space in Physics*, ed. 2 (Cambridge, Mass. 1969) 60. As we shall see below, the necessity of an immobile reference body for the occurrence of motion was challenged within the context of discussions on article 49.

⁵⁸ Thomas Bradwardine, *De causa Dei contra Pelagium et De virtute causarum* . . . (London 1618) 177 (C-D). Cited from my own translation of Bradwardine's discussion of infinite void space in Grant (n. 1 above) 557.

⁵⁹ Aristotle, *Physics* 4.4.212a.5-6. The translation is that of R. P. Hardie and R. K. Gaye in the Oxford English translations of Aristotle. I have added the bracketed qualifications. Aristotle assumed that the place, or container, is distinct and separate from the thing in place.

plenum without vacua, every body within that world was assumed to have a place because it was surrounded by a body or bodies that differed from it. In this plenum, the rectilinear motion of a body from place to place always involved departure from the innermost surface of one surrounding body to the innermost surface of another surrounding body. Local motion was thus a series of successive abandonments and acquisitions of different material containing surfaces, or places, until the body came to rest in its natural place.⁶⁰ Since every part of the world was said to be in a place, it was common to say that the world was in a place accidentally by virtue of all its parts. But most admitted, with Aristotle, that the last, or outermost, sphere was not itself in a place because no body existed beyond the world to serve as its container, or place. Indeed, no places could exist beyond the world because no bodies were there to constitute those places. Since motion was from place to place, it seemed to follow that motion of the last sphere, or the world, was impossible. And yet, article 49 demanded the concession that God could, if he wished, move that last sphere, or the world itself, with a rectilinear motion. But how could the world be moved if there were no places to receive it and from which it could depart?

It was undoubtedly with all this in mind that Walter Burley distinguished two kinds of worlds which God could have created. The first is our kind, namely a heterogeneous, or discontinuous, plenum with different bodies each forming a distinct part with its own place. In this type, those who believe, as some Arabs did, that the world is in a place *per se*, and not accidentally by reason of its parts, are committed to a precreation vacuum into which the world was placed at creation, since there is no body beyond the world which can function as a true place.⁶¹ But Christian theologians (*loquentes nostre legis*) who assume that the world is not in a place *per se*, but only accidentally by virtue of its parts, do not assume a precreation vacuum for the world, but rather assume that God created the place of the world simultaneously with the world.⁶²

These responses depend on the creation of a heterogeneous, or discontinuous, world. But what if God had created a wholly continuous, spherical world without distinct parts – that is, what if God had created a completely homogeneous universe? Such a world could have no distinct and different parts and therefore could not be in place by its parts; and since it has no external material container, the whole of it cannot be in a place. But every body must be in some place. Therefore, since this world is a single, homogeneous body, it too must be in a place. The only place it could have, Burley concludes, is a vacuum.⁶³

⁶⁰Because they are irrelevant to our purposes, I shall ignore the numerous paradoxes and difficulties associated with Aristotle's concept of place.

⁶¹"Sic igitur apparet quod ponentes totum mundum esse per se in loco et etiam de novo generari habent ponere vacuum"; Burley (n. 47 above) fol 89r, col. 1.

⁶²"Sed recte philosophantes(?) et loquentes nostre legis qui ponunt totum mundum non esse per se in loco, sed solum per partes, vel per accidens, non habent ponere vacuum quia non ponunt locum precedere generationem mundi, sed dicunt locum simul generari cum mundo"; *ibid.*

⁶³The passage now quoted follows immediately after the text in the preceding note: "Sed dubitatur quia ponentes mundum de novo generari habent dicere quod sicut Deus creavit mun-

But what if God should now move this homogeneous and continuous world in a straight line? Without external places, Burley concludes that God would first have to create a new place to which the body is moved. Thus Burley allows that God could move the world with a rectilinear motion, but not before creating an external place, or places.⁶⁴

Although none would have dared deny that, if needed, God could create those places beyond the world, a number of scholastics were unconvinced of their necessity. Indeed, they were of the opinion that place was in no way essential for motion. Article 49 and God's absolute power provided the natural impossibilities which enabled them to imagine the conditions which would make motion without place possible. In a major discussion, John Buridan⁶⁵ assumed, as Burley had, that God created a homogeneous universe in which the world is one continuous body, the potential parts of which are identical. Under these circumstances, as we saw, places as defined by Aristotle could not exist, so that no places would exist inside or outside the world. And yet, if he wished, God could move the world circularly and produce a motion without the existence of places.⁶⁶ That God could move such a world circularly is inferred from article 49, which Buridan cites as "an article condemned at Paris." For if God can move the world rectilinearly, he surely can move it circularly,⁶⁷ and do this whether it be continuous or discontinuous. But if it is continuous, the circular motion of the last sphere would not depend on any changing relationship to the earth at its center, or to any other body. For on the assumption that all things in the world share the circular motion of the last sphere and are moved simultaneously with it, all relationships between any parts of the world would remain constant and no relative motions would be detectable. And yet a motion takes place since God is assumed to move the whole world circularly.⁶⁸

dum discontinuum in partibus propter quarum discontinuationem partes mundi sunt per se in loco. Ita Deus potuit creasse unum corpus continuum omnino in omnibus partibus ita quod nihil aliud creasset quam illud rotundum continuum. Ponamus igitur quod Deus, quando creavit istum mundum, creasset loco istius mundi unum corpus rotundum omnino continuum; et cum omne corpus sit in loco, illud corpus rotundum etiam fuisset in loco et non per partes quia nulla pars esset in loco, cum locus sit continens divisum et illud corpus est omnino continuum. Ergo relinquatur quod illud corpus sit in vacuo"; *ibid.*

⁶⁴"Dicendum quod ponendo tale corpus continuum et nihil extra illud continuum, Deus non posset illud corpus movere motu recto nisi crearet locum novum ad quem moveretur"; *ibid.* Making no distinction between types of worlds, Richard of Middleton (n. 33 above) 2.186, who specifically mentions the condemnation of article 49 by the bishop of Paris, insisted that God could not move the whole last heaven, which he identifies with the Empyrean sphere, unless he also created an external space for it. Nor could God move an angel, who is assumed to be the sole existing creature in the world, unless he also created for that angel a surrounding external space.

⁶⁵Buridan (n. 36 above) fols. 50r-51r considers the problem in bk. 3, q. 7 ("Utrum motus localis est res distincta a loco et ab eo quod localiter movetur"). Occasionally emending the 1509 edition from manuscript sources, Anneliese Maier has analyzed this question in *Zwischen Philosophie und Mechanik: Studien zur Naturphilosophie der Spätscholastik* (Rome 1958) 121-131.

⁶⁶Nicholas Bonetus, a fourteenth-century Franciscan, agreed with this. See Pierre Duhem, "Le temps et le mouvement selon les scholastiques," *Revue de philosophie* 23 (1913) 459-460.

⁶⁷Buridan (n. 36 above) fol. 50v, col. 1; for the Latin text, see Maier 122.

⁶⁸Buridan, *loc. cit.*; Maier 124-125 for the Latin text.

As with circular motion, Buridan argues that rectilinear motions are also conceivable without relationships to other bodies. Here again it is article 49 which provides the basic illustration. For if God moved this continuous world rectilinearly, the outermost sphere would not change its relative positions to the earth resting at the center. And since it is assumed that nothing lies outside the world, it follows that the world's rectilinear motion is absolute and independent of any relationships to an immobile body. The independence of the world's motion is emphasized in yet another way. If, in our continuous and homogeneous world, we now assume the earth's rotation with respect to the heavens, the latter would bear different relationships to the earth. But from this one cannot properly infer a rectilinear motion of the world. Thus, in the one case, assumption of the world's rectilinear motion does not affect the relative position between the last heaven, or sphere, and the earth; and, conversely, different positional relationships between the last heaven and the earth tell us nothing as to whether the world is actually in rectilinear motion. The world's supernatural motion was thus conceivable without reference to any other body.

Some years later, Nicole Oresme agreed that the local motion of a body from place to place was not determined by its relationship to external bodies, whether immobile or mobile. The supernatural motion of the world provided an indubitable illustration of an absolute motion, one which, for Oresme, occurred in an imaginary, infinite space beyond our world, a space in which our unique world is moved as if it were a single body. For Oresme it was no contradiction to declare "that the whole world moves in this space with a rectilinear motion. To say the contrary is to maintain an article condemned in Paris. With this assumption, no other body exists with which the world could vary with respect to place."⁶⁹ After further demonstrating the independence of local motion from change of position relative to another body, Oresme declares that for a body "to be moved with respect to place is for it to bear different relationships with respect to the imagined immobile space, for it is with regard to this space that the speed of the motion and of its parts are measured."⁷⁰ Thus did article 49 lead Nicole Oresme to view the change of position of a single body in the universe against the backdrop of an absolute, infinite empty space, the existence of which for him was not hypothetical but real.

But how was an absolute rectilinear motion of the whole world to be classified? As we saw earlier, such a motion could not be identified with any of the natural

⁶⁹Oresme (n. 37 above) 367, 369. I have altered Menut's translation.

⁷⁰*Ibid.* 373. I have again changed the first part of Menut's translation. Perhaps it was with Oresme in mind that Marsilius of Inghen reported the opinion of those who "posit that there is place outside of the heavens, or an infinite space. Therefore, if God were to move the whole world rectilinearly or circularly, the world would be differently disposed with respect to the place or separate space in which it would be. Therefore, they concede that the world moved locally [in the fashion posited in the case] is disposed differently than before with respect to that which is nothing [i.e., separate space]"; translated by Marshall Clagett from Marsilius's *Questions on the Physics* in Clagett, *The Science of Mechanics in the Middle Ages* (Madison 1959) 623. The additions in brackets were added by Clagett. Although Marsilius did not reject this interpretation, he preferred another, described earlier in his treatise.

motions within the world, for which reason Aristotelians had denied the possibility of it and, according to Thomas Bradwardine, evoked the wrath of the bishop of Paris sufficiently to bring on the condemnation of article 49.⁷¹ It was undoubtedly with this problem in mind that Gaietanus de Thienis, in the fifteenth century, inferred that if God did move the world rectilinearly, as indeed he could, its motion would not be classifiable as either up or down. Rather it would belong to another species of motion, which is left unspecified and undiscussed.⁷²

It was almost inevitable that an idea such as the one that God could move the world rectilinearly should have posed difficult, and even unanswerable, questions about motion and place in the context of Aristotelian natural philosophy. Its most significant impact, however, was as further reinforcement of the concept of extracosmic void which, as we have seen, was for some an obvious consequence of article 34 on the plurality of worlds. The very text of article 49 speaks of a void being left behind if God moved the world. Since, after 1277, this consequence of the world's motion could not be invoked to deter God from moving the world if he pleased, it followed that if God moved the world, a vacuum would remain. Thus the world could be conceived as located in a vacuum.

But as the world moves from its old place, what did it move into? The obvious response was that it moved into other void places, which had existed outside the world prior to its motion. Since no good reason could be offered for a finite termination of extracosmic void, its infinitude was easily inferred, though hardly necessary, since God could just as easily create a finite space beyond the world.⁷³ Around 1344, Jean de Ripa used article 49 to establish the plausibility of extracosmic void. He achieved this by extending the notion of place from our material cosmic plenum to void space. He argued that since all positive places or spaces existed only within the material plenum of our world, it was necessary to assume the existence of imaginary, or void, places or spaces beyond our world in which bodies or angels could be received. For if only positive places existed, none of which could exist outside the world, God could not move the world with a rectilinear motion, since there would be no place or places into which the world could be moved. But this would place a restriction on God's power to move the world and was indeed

⁷¹ Bradwardine (n. 58 above) 177 (C-D) and Grant (n. 1 above) 557.

⁷² "Possumus concedere Deum posse movere mundum motu recto nullum locum creando et quod talis motus rectus non esset sursum, nec esset deorsum, sed alterius speciei"; Gaietanus (n. 47 above) fol. 28v, col. 2.

⁷³ Although Buridan did not himself accept the existence of extracosmic void space, he reports that those who held this opinion believe that if such a space did exist it would, by the principle of sufficient reason, be infinite. For why should it be of one size rather than another greater size? Whatever finite size is assumed for this space, we may always properly inquire whether another space lies beyond. Thus, "if it could be shown that there is a space there, it ought to be conceded that it is infinite." For the Latin text, see Buridan (n. 36 above) fol. 57r col. 2, bk. 3, q. 15. In reply, Buridan emphasizes that it is not necessary that such a space be infinite, since by his supernatural power, God could, if it pleased him, create only a finite space beyond the world. It was Buridan's opinion, however, that God probably did not create any space beyond the world (fol. 58r, col. 2; see also fol. 57v, col. 2).

condemned.⁷⁴ It was therefore necessary to concede that imaginary void places could also exist which were capable of receiving the whole world, or any part thereof. Although they did not formulate specific arguments of this kind, Bradwardine and Oresme had implicitly assumed much the same position.⁷⁵

In articles 139, 140, and 141, the bishop of Paris struck at some of the most basic ideas in Aristotelian natural philosophy. Not only did these articles condemn the seemingly self-evident principle that an accident could not exist without a subject in which to inhere and also condemn the widely held belief that not even God could create an accident without a subject, but they also censured the Aristotelian axiom that no quantity or dimension could exist independently of a material body — for this would make it a substance — and the equally basic principle that two or more dimensions could not exist simultaneously in the same place.⁷⁶

It was indeed with these articles and their implications that Jean Buridan concerned himself in a question devoted to the possibility that a certain power might create a vacuum.⁷⁷ Painfully aware of the theological ramifications of the question, Buridan provides a rare insight into the strained relations between theology and philosophy. Admitting that masters from the arts faculty were sworn not to discuss any purely theological questions,⁷⁸ and readily conceding that the question of the existence of a vacuum touched faith and theology, Buridan insists that he be allowed to pursue the theological aspects of the question or be guilty of perjury and

⁷⁴“Jean de Ripa I Sent. dist. XXXVII: De modo inexistendi divine essentie in omnibus creaturis,” ed. André Combes and Francis Ruello, introduction by Paul Vignaux, *Traditio* 23 (1967) 232 lines 66-68; the argument is repeated on 234 lines 6-9. De Ripa also argued for the existence of imaginary space by appeal to angels. If an angel existed alone with everything else corrupted, including all positive places, that angel would be nowhere and unable to change positions. Since this is patently absurd, de Ripa infers the existence of imaginary places and spaces wholly independent of material bodies and media. See 232 lines 60-66 and 234 lines 6-8.

⁷⁵That Bradwardine and Oresme believed that extracosmic space was necessarily infinite and real derives from their belief that infinite space is God's infinite immensity and therefore in no way created. For de Ripa, God's creation of an actual infinite space would be an instantiation of his general power to create actual infinities. To deny God the power to create an actual infinite would be a restriction of his absolute power. See Grant (n. 49 above) 149-150.

⁷⁶“139. That an accident existing without a subject is not an accident, except equivocally; and that it is impossible that a quantity or dimension exist *per se*, since this would make it a substance.” (“Quod accidens existens sine subjecto non est accidens, nisi equivoco; et quod impossibile est quantitatem sive dimensionem esse *per se*; hoc enim esset ipsam esse substantiam.”)

“140. That to make an accident exist without a subject is an impossible argument implying a contradiction.” (“Quod facere accidens esse sine subjecto, habet rationem impossibilis, implicantis contradictionem.”)

“141. That God cannot make an accident exist without a subject, nor make several dimensions exist simultaneously [in the same place].” (“Quod Deus non potest facere accidens esse sine subjecto, nec plures dimensiones simul esse.”) Denifle and Chatelain (n. 1 above) 1. 551.

⁷⁷Buridan (n. 36 above) fols. 73v-74r, bk. 4, q. 8 (“Queritur octavo utrum possibile est vacuum esse *per aliquam potentiam*”).

⁷⁸The reference is probably to the statute of 1272. For the Latin text, see Denifle and Chatelain (n. 1 above) 1. 499-500; the English translation by Lynn Thorndike appears in his *University Records and Life in the Middle Ages* (New York 1944) 85-86.

evasion.⁷⁹ Adopting a position by then conventional, he admits that God can create an accident without a subject, or that he can separate, and independently conserve, accidents from their subjects. As a special case, Buridan concedes that God could create a separate dimension independently of any substance or other accidents. Moreover, God could also create several bodies in the same precise place and cause the interpretation of dimensions by creating a separate, three dimensional void space that could receive natural bodies.⁸⁰

But there is a second kind of vacuum, which results from the annihilation of all matter between the surfaces of the containing body which serves as the place of the annihilated body. In order that a vacuum result, the bounding surfaces of the containing body, or place, must retain their figure and not collapse together in abhorrence of a vacuum.⁸¹ God could not only create such a vacuum by annihilating all the matter within the confines of the concavity of the lunar orb, but he could also preserve the capacity to see and hear in this vacuum by retaining and preserving the spatial configurations of air and water while destroying the air and water. God could then place two men in the region where air formerly existed and they would be able to see and speak to each other without the material air serving as a medium of visual and audio transmission.⁸²

Buried amidst all these natural impossibilities, and, to many in the Middle Ages, undoubted absurdities, was the idea of a separate space existing independently of material body. What articles 34 and 49 did for the existence of extracosmic space, articles 139, 140, and 141 did, somewhat less intelligibly perhaps, for possible dimensional spaces within the world. Thus Walter Burley was prepared to argue that if such a separate quantity, or dimensional vacuum, existed in the same manner as Catholics assume the existence (in the Host) of a quantity separated from every substance and from all qualities, light and heavy bodies would be able to move

⁷⁹ For my translation of Buridan's remarks, see Grant (n. 1 above) 50-51.

⁸⁰ After declaring his belief that the divine power can create the two different types of vacuum imagined in the preceding question, Buridan says that this is not proved by natural reason. In turning to the first mode, which is a three dimensional separate vacuum, Buridan says: "Primo ergo quantum ad primum modum imaginandi vacuum esse ego pono quod Deus potest facere accidens sine subiecto et potest accidentia separare a subiectis suis et separatim conservare. Ideo potest simplicem dimensionem creare absque hoc quod cum ea sit aliqua substantia vel etiam aliquid accidens distinctum ab ea. Secundo, videtur michi quod non est apud Deum impossibilis penetratio dimensionum. Immo ipse potest plura corpora facere esse simul in eodem subiecto vel in eodem loco absque hoc quod differant ab invicem secundum situm, scilicet absque hoc quod unum sit extra alterum secundum situm. Ergo Deus potest facere simplicem dimensionem sive spacium ab omni substantia naturali separatum in quo vel cum quo absque hoc cedat recipi possunt corpora naturalia. Et hoc vocabatur vacuum secundum primam imaginationem"; Buridan (n. 36 above) fol. 74r, bk. 4, q. 8. For the two kinds of vacuum, see q. 7 on fol. 73r, col. 2.

⁸¹ "Deinde de secundo modo imaginandi credo sicut prius arguebatur quod Deus posset annihilare istum mundum inferiorem conservando celum, magnitudines et figuras quales et quantas nunc habet, et concavum orbis lune esset vacuum et de hoc et de dubitationibus circa hoc accidentibus dictum fuit satis in decimaquinta questione tertii libri"; *ibid.* fol. 74r, col. 1.

⁸² *Ibid.*

through it successively as if they were moving through a medium.⁸³ In this manner did Burley link the condemned articles on the supernatural separation of accidents from their subjects, or attributes from their substances, with the much discussed medieval problem of motion in a separate space.⁸⁴

Although Jean Buridan probably opposed the Condemnation of 1277 and endorsed, privately at least, those articles that were supportive of Aristotelian physics and cosmology, he was not above using certain of the natural impossibilities to his own advantage, as we already saw with article 49. He would do the same with article 141, which he found a convenient support for his conception of the true nature of motion. Convinced that the motion of the last celestial sphere could not be identified with either the sphere itself or the place of that sphere, if it had any, Buridan⁸⁵ rejected William Ockham's definition of motion which equated motion with the mobile and the successive places it occupied.⁸⁶ For Buridan, motion was a non-permanent, pure flow — a *res pure successiva* — in which each part passes away when its successor comes into being. The changing relationships exhibited by the last sphere, or heaven, arise from the impossibility of prior and posterior parts of motion existing simultaneously, for if successive parts of motion could exist simultaneously, motion would be a permanent quality, or accident, similar to the magnitude or shape of a body, which can remain constant over successive moments.⁸⁷ Motion is thus a disposition, or an accidental form, inhering in a body. But if motion is an accidental form or quality, would it not, then, be possible for God to destroy a body and the places it might occupy and yet conserve its motion as an independent entity? Whoever posed this question, whether Buridan himself or opponents of his concept of the nature of motion, was undoubtedly aware of article 141 of the Condemnation of 1277, which had denounced those who would argue "That God cannot make an

⁸³ "Ponendo tamen quantitatem separatam eo modo quo Catholici posuerunt quantitatem posse separari a substantia et ab omni qualitate, sic esset dicendum, ut opinor, quod grave vel leve posset moveri motu successivo in tali quantitate tanquam in medio"; *ibid.* fol. 116v, col. 2. Earlier, Burley had designated this type of vacuum as "less impossible" (*minus impossibilis*) than a vacuum which is neither a natural body or a separate quantity. Of this "less impossible" kind of vacuum, he says: "quod sit aliqua quantitas longa, lata, et profunda separata ab omni qualitate [corrected from "quantitate"] sensibili quoniam secundum theologos illud est possibile apud Deum, sicut in sacramento altaris est quantitas sine omni substantia corporea in qua sit sicut in subiecto. Ita Deus posset facere quantitatem esse sine omni qualitate et talem quantitatem separatam receptivam corporis; et hanc dixerunt aliqui antiquorum esse vacuum"; *ibid.* fol. 116v, col. 1. It would appear that articles 139, 140, and 141 were condemned because they would have denied the Eucharist, which required that qualities exist without subjects in which to inhere.

⁸⁴ See the section "Motion in a Hypothetical Void," in Grant (n. 1 above) 334-350.

⁸⁵ Buridan considers the problem in the same question discussed above, where, in a fourth conclusion, he declares "quod motus ultime spere non est illa spera nec locus eius" (n. 36 above) fol. 50v, bk. 3, q. 7; see also Maier (n. 65 above) 126.

⁸⁶ For Ockham's definition, see *Tractatus de successivis Attributed to William Ockham*, ed. Philotheus Boehner, O.F.M., Franciscan Institute Publications 1 (St. Bonaventure, N.Y. 1944) 46; for a translation of the passage, see Herman Shapiro, "Motion, Time and Place According to William Ockham," *Franciscan Studies* 16.3 (1956) 251-252.

⁸⁷ Buridan (n. 36 above) fol. 50v, col. 2; Maier (n. 65 above) 126-127.

accident exist without a subject.” The bishop of Paris, Étienne Tempier, could have found no fault with Buridan’s response some sixty years later, when the latter declared that “I do not consider it more absurd that there could be a motion and nothing would be moved than that there could be whiteness and nothing that would be white. Neither is possible naturally but each is possible supernaturally.”⁸⁸

Thus not only did Buridan use article 49 to help establish the absolute nature of motion, but he found article 141 useful in a negative sense in winning acceptance for the idea that motion is a quality and therefore subject to the same fate as any other quality. If it was required at Paris to concede that God could make a quality exist separately from its subject, then so also could he make a motion exist separately from its subject. While Buridan may have invoked article 141 negatively, and perhaps even defensively, the idea that a quality could exist supernaturally without its subject, and the further idea, embodied in article 140, that the separate existence of a quality did not imply a contradiction, may have played a role in the development of the medieval doctrine of the configuration of qualities in which the addition of qualities without subjects was a basic concept.⁸⁹ It was within the context of this doctrine that the famous Merton College “mean speed theorem” was derived and which eventually served as the foundation of Galileo’s new mechanics.⁹⁰

Buridan’s concept of the nature of motion, in which article 49 played a significant role, and article 141 a minor role, has been interpreted by Anneliese Maier as containing the germ of an inertial theory.⁹¹ For if motion inheres in a body just as a quality does, the former would be independent of external or internal movers and ought, therefore, to remain in existence until destroyed by external resistances. Although Buridan drew no such inference and failed to exploit the inertial possibilities, it should be obvious by now that the articles of the Condemnation of 1277 mentioned thus far were influential primarily in discussions about space and motion.

But there were yet other articles which played a role in discussions about space and motion, as well as a wide range of other topics. Certain articles concerned the location, movement, and activities of angels and intelligences.⁹² Of these, some were especially controversial because Thomas Aquinas had held them. Thus article 204⁹³ condemned the opinion that a separate substance could be everywhere by means of

⁸⁸ Buridan (n. 36 above) fol. 51r, col. 1; see also Maier 129.

⁸⁹ William of Ware may have been the first to propose the idea. See Edith Sylla, “Medieval Quantification of Qualities: The ‘Merton School,’” *Archive for History of Exact Sciences* 8.1/2 (1971) 11-12 n. 9.

⁹⁰ See Clagett (n. 70 above) 255-418, chaps. 5-6.

⁹¹ Maier (n. 65 above) 133.

⁹² See Duhem (n. 1 above) 6.22, 29-59; on condemned articles concerned with celestial motions, see 59-66.

⁹³ “204. Quod substantie separate sunt alicubi per operationem; et quod non possunt moveri ab extremo in extremum, nec in medium, nisi quia possunt velle operari aut in medio, aut in extremis. — Error, si intelligatur, sine operatione substantiam non esse in loco, nec transire de loco ad locum”; Denifle and Chatelain (n. 1 above) 1.554.

the action it exercised. This meant that an angel could not move from one extremity to another, or move through the middle of anything unless it wished to act in any of these places. If it wished to act only in the middle it could do so directly without having arrived there from either extremity. With the condemnation of article 204, it also seemed plausible to condemn article 219, which held that separate substances are nowhere, that is, not in a place according to their substance.⁹⁴ Although dead some three years prior to the Condemnation of 1277, Aquinas's works contained opinions that were clearly in violation of articles 204 and 219. With respect to location and movement, he had treated spiritual substances in a manner radically different from bodies. For Aquinas, a body is in place by the contact of its volume with the innermost surface of the containing body that surrounded and touched it at every point. However, since an angel is not a corporeal volume, Aquinas concluded that it could not be in a place, and inferred from this that it acted in places by its will, or desire, and not by the presence of its substance.⁹⁵ Consequently, an angel could, if it wished, also apply itself to a place by its power without passing through all the intervening points with a continuous motion.⁹⁶

In upholding the condemnation of article 204, Duns Scotus⁹⁷ was critical of those, including Aquinas, who would assign to an angel, which possessed only finite power, unlimited power to act wherever it pleased, thus conferring on it a power that was only appropriate to God. It also appeared absurd to Scotus that if an angel were to pass from heaven to earth, it could do so without passing through, or acting on, the intermediate places.⁹⁸ Rejecting "action at a distance" for separate substances other than God, Scotus, and those who supported the condemnation, required that an angel act in a place only by "occupying" that place. To reach that place, however, it must pass through all the intervening points between its *terminus a quo* and *terminus ad quem* – that is, its motion must be successive and continuous. Although there was disagreement, the condemnation of articles 204 and 219 was upheld in a variety of interpretations, by numerous other fourteenth-century scholastics, includ-

⁹⁴ "219. Quod substantie separate nusquam sunt secundum substantiam. – Error, si intelligatur ita, quod substantia non sit in loco. Si autem intelligatur, quod substantia sit ratio essendi in loco, verum est, quod nusquam sunt secundum substantiam"; *ibid.* 555.

⁹⁵ Thomas Aquinas (n. 28 above) q. 52, art. 1 ("Utrum angelus sit in loco"), p. 326a.

⁹⁶ *Ibid.*, q. 53, art. 2 ("Utrum angelus transeat per medium"), p. 330b.

⁹⁷ John Duns Scotus, *Quaestiones in lib. II sententiarum*, dist. 2, q. 6 ("An locus angeli sit determinatus, punctualis, maximus, et minimus?") in *Opera omnia* 6.1 (Lyons 1639; repr. Hildesheim 1968) 189. Scotus's discussion is especially significant because he says that this article was condemned by the bishop of Paris, and that although it might be said that the penalty of excommunication does not "cross the sea" – i.e., does not apply to England – an article that is judged heretical is to be condemned everywhere, not only by authority of the diocese, but also by authority of the pope; at the very least, he adds, an opinion condemned at a university ought to be suspect.

⁹⁸ *Ibid.* 189-190. See also Edward Grant, "Medieval and Seventeenth-Century Conceptions of an infinite Void Space beyond the Cosmos," *Isis* 60 (1960) 50 n. 50, where Scotus allows that God could act at a distance in places remote from his presence. Such power was not, however, possessed by angels.

ing Peter Aureoli,⁹⁹ William Ockham,¹⁰⁰ Thomas of Strasbourg,¹⁰¹ and John Baconthorpe.¹⁰²

In his discussion of the question “whether an angel is in place by its substance,” Ockham cites article 219 and resolves the problem by opting for one of two traditional ways in which a thing could be conceived to be in a place, namely circumscriptively or definitively.¹⁰³ The former is excluded because it assumes that every part of a thing is in a part of the place, and that the whole thing is in the whole place, a description applicable only to bodies. But an angel can be in a place definitively, since a thing is said to be in a place definitively “when the whole is in the whole place and not outside it, and the whole is in any part of the place, as the body of Christ is in place definitively in the Eucharist because his whole body exists (*coassistit*) in the whole place of the consecrated species and his whole body exists (*coassistit*) in any part of the place.”¹⁰⁴ Ockham thus interpreted article 219 to mean that an angel is only in a place definitively and not circumscriptively.¹⁰⁵ With angels assumed to exist in a place by their substances, albeit in a special way, Ockham and many others would then consider whether angels could be moved locally¹⁰⁶ — that is, from place to place — and whether they could move successively through a vacuum.¹⁰⁷

Many other articles of the Condemnation of 1277 played a role in the physical and cosmological discussions of the fourteenth century with varying degrees of impact. There were articles relevant to the generation and creation of things,¹⁰⁸ celestial movers (angels and intelligences),¹⁰⁹ and the eternity of the world and things in the world.¹¹⁰ Indeed, Bradwardine had invoked article 52,¹¹¹ that “many things are

⁹⁹Petrus Aureoli, *Commentariorum in secundum librum sententiarum tomus secundus* (Rome 1605) 52-53, bk. 2, dist. 2, art. 2 (“Utrum angeli sint creati in caelo Empireo sicut in loco”). Art. 204 is explicitly alluded to as “articulus excommunicatus Parisijs” (52, col. 2).

¹⁰⁰Ockham (n. 19 above) quotlib. 1, q. 4: “Utrum angelus sit in loco per suam substantiam,” sig.a4r-a4v.

¹⁰¹Thomas of Strasbourg (n. 33 above) fols. 107r-108r, bk. 1, dist. 37, q. 1 (“An substantia quaelibet spiritualis in loco existat?”), where articles 204 and 219 are specifically cited.

¹⁰²John Baconthorpe not only cites articles 204 and 219, but actually refers to them by number, although erroneously (he lists them as 22 and 218, respectively). See Baconthorpe, *Super quatuor sententiarum libros* (Venice 1526) fol. 144v, bk. 2, dist. 3, q. 2, art. 3 (“An ex parte angeli sit possibilitas ut locetur”).

¹⁰³Ockham (n. 19 above) quotlib. 1, q. 4, sig.a4r, col. 1.

¹⁰⁴*Ibid.*

¹⁰⁵“Ad principale dico quod angelus non est circumscriptive in loco per substantiam; et sic intelligitur articulus Parisiensis; sic est verus et non aliter”; *ibid.* sig.a4v, col. 1.

¹⁰⁶*Ibid.*, q. 5 (“Utrum angelus possit moveri localiter”), sig.a4v.

¹⁰⁷*Ibid.*, q. 6 (“Utrum angelus possit moveri per vacuum”), sig.a5r.

¹⁰⁸See Mandonnet (n. 1 above) 181.

¹⁰⁹*Ibid.* 179-180, for a lengthy list of errors on intelligences; see also Duhem (n. 1 above) 6.29-59, where some of them are discussed.

¹¹⁰Mandonnet 182-183.

¹¹¹“52. Quod id, quod de se determinatur ut Deus, vel semper agit, vel numquam; et, quod multa sunt eterna”; Denifle and Chatelain (n. 1 above) 1.546.

eternal," in order not only to argue that this limited God's absolute power to destroy them, and was therefore rightly condemned, but also to apply it against a famous Aristotelian dilemma, made fully explicit by Averroes, that either the world is eternal, which Aristotle believed, or that an independent, uncreated, and presumably eternal, precreation void space must have existed in which the world was created.¹¹² Since neither of these alternatives was acceptable to a Christian, for whom only God could be eternal, the condemnation of article 52 made both alternatives untenable.¹¹³

Since the concept of a regular, lawful and deterministic world had great appeal for many astrologers and for those who followed Greek tradition as described in Stoic and Aristotelian thought, quite a few articles were directed against deterministic astrology¹¹⁴ and the idea that not even God could intervene in the natural order by creating new effects.¹¹⁵ Denial of new effects and the assumption of deterministic astrology were embodied in the Stoic concept of a Great Year which assumed the complete recurrence of all events and individuals over fixed periods of time, usually 36,000 years based on the Ptolemaic value for precession of the equinoxes of 1° in 100 years. It was clearly the Great Year which the bishop of Paris had in mind, when, in article 6, he condemned the belief "That when all celestial bodies have returned to the same point — which will happen in 36,000 years — the same effects now in operation will be repeated."¹¹⁶

Well aware of the existence of article 6, Nicole Oresme formulated a series of mathematical propositions by means of which "many errors about philosophy and faith could be attacked . . . as [for example] that [error] about the Great Year which some assert to be 36,000 years, saying that celestial bodies were in an original state and then return [to it in 36,000 years] and that past aspects are arranged again

¹¹²See Aristotle, *De caelo* 3.2.301b.31-302a.9. For Averroes's version, see his *Commentary on Aristotle's Physics*, bk. 4 comm. 6, in *Aristotelis omnia quae extant Opera*. . . , 9 vols. and 3 supplements (Venice 1562-1574; repr. Frankfurt a.M. 1962, as *Aristotelis Opera cum Averrois commentariis*) vol. 4 fols. 123v col. 2-124r col. 1, a commentary on Aristotle's *Physics* 4.1.208b.25-33.

¹¹³For Bradwardine's argument, see the translation from the *De causa Dei* in Grant (n. 1 above) 558, col. 1. Surprisingly, Bradwardine did not cite article 201, which condemned the opinion "That one who generates the whole world [i.e., one who believes the world is divinely created or has come into being naturally] assumes a vacuum because place necessarily precedes what is generated in a place; and so before the generation of the world, there was a place without a thing located in it, which is a vacuum." ("201. Quod, qui generat mundum secundum totum, ponit vacuum, quia locus necessario precedit generatum in loco; et tunc ante mundi generationem fuisset locus sine locato, quod est vacuum"; Denifle and Chatelain [n. 1 above] 1.554.) Art. 201 seems clearly directed against the arguments of Aristotle and Averroes cited in the preceding note

¹¹⁴For a list, see Duhem (n. 1 above) 8.419-423 and, for a discussion, 423-501.

¹¹⁵For example, article 48 declared "That God cannot be the cause of a new act [or thing], nor can he produce something anew." ("Quod Deus non potest esse causa novi facti, nec potest aliquid de novo producere"; Denifle and Chatelain [n. 1 above] 1.546.) The translation is from Grant (n. 1 above) 48. For other relevant articles, see numbers 21, 87, and 88.

¹¹⁶"6. Quod redeuntibus corporibus celestibus omnibus in idem punctum, quod fit in xxx sex milibus annorum, redibunt idem effectus, qui sunt modo"; Denifle and Chatelain 1.544.

as of old.”¹¹⁷ The mathematical propositions, which Oresme had devised and discussed in a number of treatises,¹¹⁸ demonstrated the probability that any two or more celestial motions were probably incommensurable. From this probable celestial incommensurability, Oresme argued that if the celestial spheres commenced their motions from some particular configuration, it was highly unlikely that they would again arrive at that same arrangement in any fixed interval of time. He further inferred that, if terrestrial events are caused by celestial events, as was commonly believed, unique celestial dispositions, such as conjunctions, that would occur as a consequence of probable celestial incommensurability, could cause unique effects or events, as, for example, a new species. Moreover, precise astrological prediction would be impossible as would the determination of the length of the solar year and the construction of an exact calendar.¹¹⁹ Although the condemnation of article 6 may not have been the sole inspiration for Oresme’s fascinating venture into the realm of mathematical incommensurability and its possible physical consequences, it probably played a significant role¹²⁰ and was therefore ultimately responsible for subsequent discussions by authors who drew their knowledge of this subject directly or indirectly from the works of Oresme.¹²¹

Frequent citation of, and implicit allusions to, numerous articles of the Condemnation of 1277 should convince us that it was taken seriously throughout the fourteenth century and that it encouraged innumerable invocations of God’s absolute power in a variety of hypothetical physical situations. The supernatural alternatives which medieval scholastics considered in the wake of the condemnation conditioned them to consider possibilities outside the ken of Aristotelian natural philosophy, and usually in direct conflict with it. So widespread was the contemplation of such hypothetical possibilities in the late Middle Ages that it is no exaggeration to view them as an integral feature of late medieval thought. The infinite power of God to perform certain acts as specified in the various articles of the condemnation was soon extended to almost any impossible act, which is not surprising in view of the license to formulate impossibilities granted by article 147. Scholastics were thus encouraged

¹¹⁷ See chap. 4 of Oresme’s *De proportionibus proportionum* in Edward Grant, ed. and trans, Nicole Oresme “*De proportionibus proportionum*” and “*Ad pauca respicientes*” (Madison 1966) 307. For a discussion of the Great Year, see Nicole Oresme and the *Kinematics of Circular Motion: Tractatus de commensurabilitate vel incommensurabilitate motuum celi*, ed., intro., trans., commentary by Edward Grant (Madison 1971) 103-124.

¹¹⁸ Primarily in his *De proportionibus proportionum*, *Ad pauca respicientes*, and *Tractatus de commensurabilitate vel incommensurabilitate motuum celi*; but also in his *Questiones super de celo* and *Le Livre du ciel et du monde*. The contributions of all these treatises are discussed by Grant, *Kinematics* (n. 117 above).

¹¹⁹ For Oresme’s arguments in these instances, see *ibid.* 55-67. For Marsilius of Inghen’s conclusion that celestial incommensurability could generate new effects, see *ibid.* 127-128.

¹²⁰ Duns Scotus may also have been influenced by article 6, when he denounced, as contrary to faith, the concept of an exact cyclical return and argued further that if the celestial motions are incommensurable, a Great Year could not occur; *ibid.* 118-120.

¹²¹ On Henry of Hesse, Marsilius of Inghen, Pierre d’Ailly, and Jerome Cardano, see *ibid.* 124-161; see also 122-124 n. 99.

to explore the consequences of such acts, and, as we have already seen, frequently did so.

Of all the areas of physical thought that were affected by the Condemnation of 1277 and its concomitant idea of God's absolute power, none was influenced more than the concept of vacuum. Not only was the possible existence of vacuum a theological problem because, as Gregory of Rimini put it, every Catholic had to concede the possibility that God could create one,¹²² but also because it raised the question as to whether God required an empty space in which to create the world, a view condemned by article 201, which we cited earlier. We have already seen that by postulating other worlds and the motion of our world, articles 34 and 49 generated serious discussion of the possible existence of extracosmic void space. Although no articles of the Condemnation of 1277 concerned vacua within our cosmos, it seemed obvious that if God could create a vacuum beyond the world, he surely could do so within the world. And so it was that God was frequently imagined to annihilate all or part of the matter within the material plenum of our world.¹²³ Within this wholly or partially empty space all sorts of situations were imagined after 1277, and the questions raised came to be commonly discussed in the large literature on the nature of vacuum and the behavior of bodies placed within it. Would the surrounding celestial spheres collapse inward instantaneously as nature sought to prevent formation of a vacuum?¹²⁴ Indeed, would the empty interval, or nothingness, be a vacuum

¹²² "Similiter si vacuum foret, sicut possibile esse per potentiam Dei, saltem quilibet Catholicus habet concedere, quodlibet grave per quantamcumque finitam distantiam descenderet in instanti"; Gregory of Rimini, *Super primum et secundum sententiarum*, ed. E. M. Buytaert, Franciscan Institute Publications, Text Series 7 (1522; repr. St. Bonaventure, N.Y. 1955) fol. 50v, bk. 2, dist. 6, q. 2. Gregory completed his lectures on the *Sentences* in 1344 and added to them in 1351. Earlier (at n. 79 above), we saw that Buridan called the question of the existence of vacuum a theological problem. See also Henry of Ghent's statement that a Catholic ought not to deny that God could make a vacuum if he wished; Koyré (n. 18 above) 58 n.1.

¹²³ Because of their essentially theological context, medieval discussions of the annihilation of matter to create a vacuum were probably not derived from Aristotle, who is not even mentioned in this connection, despite his brief summary of earlier opinions that place must precede the things in it and therefore be "a marvellous thing, and take precedence of all other things. For that without which nothing else can exist, while it can exist without the others, must needs be first; for place does not pass out of existence when the things in it are annihilated." *Physics* 4.1.208b.33-209a.1 in the translation by Hardie and Gaye. In Averroes's commentary on the *Physics*, the text appears in bk. 4, text 7 (see *Aristotelis omnia quae extant Opera* [n. 112 above] vol. 4, fol. 124 cols. 1-2).

¹²⁴ Ockham, for example, argued that if God preserved the heaven and destroyed all else within it, the sides of the heaven would not collapse inward and come into contact to prevent formation of a vacuum. For such a collapse would be either instantaneous or successive; if the former, it would not be called a local motion because a body in instantaneous motion would not pass through the mid point of the distance to be traversed, but would arrive at its terminus in a durationless moment, which is impossible. But if the motion were successive, it would occur in a measurable time; therefore, in the first part of that time, a vacuum would occur before the sides of the heaven came into contact. See Ockham (n. 19 above) *Quotlibeta septem*, quotlib. 1, q. 6, sig.a5v, col. 1. Buridan, along with other scholastics, assumed that when God annihilated everything within the lunar orb, he also preserved the shape and configuration of the lunar orb and the heavens. Hence the celestial spheres would not collapse inward, since God preserved them as before. See Buridan (n. 36 above) fol. 57v, bk. 3, q. 15 ("Utrum est aliqua magnitudo infinita").

or space?¹²⁵ With all the matter destroyed within the concave surface of the last celestial sphere, would it be meaningful to consider that concave surface a place?¹²⁶ Could a stone placed within such a void be capable of rectilinear motion?¹²⁷ Would it be possible to measure distances within such a vacuum?¹²⁸ If people were placed in it, would they be able to see and hear each other?¹²⁹ And, on the commonly accepted assumption that the behavior of bodies in the sublunar region is ordained and governed by celestial and superior causes, what would happen to a spherically shaped piece of earth located in the air enclosed within a house, if God destroyed everything, including the celestial spheres, outside that house?¹³⁰ Analysis of these, and similar, "thought experiments" in the late Middle Ages was often made in terms of Aristotelian principles even though the conditions imagined were "contrary to fact" and impossible within Aristotelian natural philosophy.

God's absolute power had thus become a convenient vehicle for the introduction of subtle and imaginative questions, which generated novel replies; and though the speculative responses did not replace, or cause the overthrow of, the Aristotelian world view, they did challenge some of its fundamental principles and force their attention on the medieval mind. They made many aware that things might be quite otherwise than were dreamt of in Aristotle's philosophy.

For other interpretations, see Edward Grant, "Medieval Explanations and Interpretations of the Dictum that 'Nature Abhors a Vacuum,'" *Traditio* 29 (1973) 331 and n.7.

¹²⁵Buridan argues that if God destroyed all matter within the lunar orb, there would be "nothing" there, not even a vacuum or space, since the latter are not positive things. Thus it implies a contradiction to say that "nothing" (*nihil*) is left after God destroys everything within the lunar orb, and then to infer that a vacuum or space is there. It is not the intervening nothing that is to be described as a vacuum, but only the surrounding concave lunar surface, "for the concave surface of the heaven is now a place filled with body or bodies, and then [after God destroyed everything] it would be a place not filled with body; thus this surface is a vacuum"; Buridan (n. 15 above) 95, bk. 1, q. 20. Buridan arrived at the same conclusion in his *Questiones* (n. 36 above) fol. 57v, col. 2, bk. 3, q. 15.

¹²⁶Johannes Canonicus concluded that if God destroyed everything within the last sphere, a possibility which all Catholics had to concede, and the inner surface of the last sphere remained, it would no longer constitute a place since the nature of a place is to be in contact with a body; Johannes Canonicus, *Questiones super VIII lib. Physicorum Aristotelis perutiles* . . . (Venice 1520) fol. 40r, q. 1.

¹²⁷See Buridan (n. 36 above) fol. 58r, col. 1, bk. 3, q. 15.

¹²⁸Although Richard of Middleton denied that the heaven could be said to be distant from the earth if everything between them was destroyed (n. 33 above) 2.186 (bk. 2, dist. 14, q. 3), Henry of Ghent, Jean de Ripa, and William of Ware thought such measurements were possible (see above, notes 49, 50, and 52). While Buridan denied that the distance between the poles of the lunar orb would be measurable rectilinearly if all things were annihilated within it, he did allow that under such circumstances curvilinear distances could still be measured along the surface of the lunar orb (see Buridan [n. 36 above] fol. 58r, bk. 3, q. 15; for a similar opinion by Marsilius of Inghen, see Grant [n. 49 above] 151).

¹²⁹A problem discussed by Buridan (see above at n. 82).

¹³⁰In considering this problem, Buridan concluded that the piece of earth would not move at all "because there is no more reason why it should be moved toward one part than to another, since one part of air would be no more up or down than another; nor would there be another power in one [part] than another because the governance of the heaven would have been removed"; Buridan (n. 15 above) 86-87, bk. 1, q. 18.

But if the oft discussed natural impossibilities and their consequences failed to overthrow Aristotelian physics and cosmology during the late Middle Ages, their influence and utility outlived the age which spawned them. Although knowledge of the Condemnation of 1277 had long disappeared,¹³¹ some of the problems and solutions which had emerged as a direct consequence of it continued to exercise influence in the late sixteenth and seventeenth centuries, not only on scholastic authors, who were preserving and extending traditional arguments, but also on nonscholastic authors, who were not unaware of the topics debated by their scholastic contemporaries.

God's absolute power to create matter beyond our world and to annihilate that matter, as well as some or all of the matter within our world, was widely discussed in the seventeenth century. Two Jesuits, Francisco Suarez and Bartholomaeus Amicus, allowed that God could create other noncontiguous worlds beyond ours between which a vacuum would exist.¹³² Suarez also invoked God's power to annihilate matter within the world and made it the basis for demonstrating the existence of a void space in which measurements could be made just as in a plenum.¹³³ John Locke took a similar approach in arguing for the existence of a three dimensional void space. Since no one could deny that God was capable of annihilating any part of matter, it followed that a vacuum would remain if God did indeed destroy a body, "for it is evident that the space that was filled by the parts of the annihilated body will still remain, and be a space without a body."¹³⁴ Somewhat more intricately, but following the same pattern, Pierre Gassendi arrived at the actual existence of an infinite, dimensional void space by first imagining the supernatural annihilation of all matter within the sublunar region, then in the celestial region beyond, and then in a world imagined successively larger and larger. For "if there were a larger world, and a larger one yet, on to infinity, God successively reducing each of them equally to nothingness, we understand that the spatial dimensions would always be greater and greater, on to infinity," so that we can "likewise conceive that the space with its dimensions would be extended in all directions into infinity."¹³⁵ With Thomas Hobbes, the annihilation of matter became a principle of

¹³¹ That an occasional reference might still appear in the seventeenth century is evident in Thomas Campanella's *Defense of Galileo*, where Thomas Aquinas's attempt to unite Aristotle and Christian theology is said to have been "rebuked in the Articles of Paris." See "The Defense of Galileo of Thomas Campanella . . .," ed. and trans. Grant McColley, *Smith College Studies in History* 22, nos. 3-4 (April-July 1937) 40.

¹³² See Francisco Suarez, *Disputationes metaphysicae*, 2 vols. (Paris 1866; repr. in facs. Hildesheim 1965; first printed, 1597) 2.106, col. 1; and Bartholomaeus Amicus (n. 16 above) 2.746 col. 2(C), tract. 21 (*De vacuo*). In his *Elements of Philosophy*, Thomas Hobbes also allowed that God could create other worlds, but, rather than discuss the void between them, Hobbes emphasized that these other worlds would have to be created in empty spaces beyond our world. *The English Works of Thomas Hobbes of Malmesbury*, ed. William Molesworth, 1 (London 1839) 93.

¹³³ Suarez (n. 132 above) 2.106, cols. 1-2.

¹³⁴ John Locke, *An Essay Concerning Human Understanding*, bk. 2, chap. 13, par. 22, in J. A. St. John, ed., *The Philosophical Works of John Locke*, 2 vols. (London 1903-1905) 1.295.

¹³⁵ From Gassendi's *Syntagma philosophicum*, Physica, sect. 1, lib. 2, "De loco et duratione

analysis. Despite omission of God as annihilator, Hobbes paid unwitting tribute to his scholastic predecessors when he declared that "In the teaching of natural philosophy, I cannot begin better (as I have already shewn) than from *privation*; that is, from feigning the world to be annihilated,"¹³⁶ a process, which, among other things, enabled him to formulate his concepts of space and time.

And there is more than an echo in the seventeenth century of that condemned article which made it mandatory after 1277 to concede that God could move the world rectilinearly despite the vacuum that might be left behind. Thus Bartholomaeus Amicus (1562-1649) speaks of God moving the world rectilinearly in connection with problems and paradoxes about the Aristotelian concept of place. If God moved the world toward the antipodes both the earth and the concave surface of the lunar orb would move simultaneously. However, since the earth is conceived as immobile and the place we call "down," and the positionally immobile concave surface of the lunar orb is the place we call "up," it follows that the rectilinear motion of the world would cause the "immobile" places "up" and "down" to move simultaneously.¹³⁷ Indeed, if God preserved the positions of all the sublunar elements while he moved the world rectilinearly, then, if air is assumed to be the containing place of the earth, the motion of the world would cause a simultaneous motion of earth and air even though the earth did not change its relative position with respect to the air. Thus we would have a motion without a change of place!¹³⁸ Pierre Gassendi found the supernatural motion of the world a convenient support for the absolute immobility of infinite space when he declared that "it is not the case that if God were to move the World from its present location, that space would follow accordingly and move along with it."¹³⁹ In his dispute with Leibniz, Samuel Clarke, speaking for Newton in that famous controversy, also defended the existence of absolute space by arguing that "if space was nothing but the order of things coexisting [as Leibniz maintained]; it would follow that if God should remove the whole material world entire, with any swiftness whatsoever; yet it would still always continue in the same place."¹⁴⁰ Rejecting this consequence, Clarke insisted that such a motion would be absolute even though unrelated to any other external body, a judgment strikingly similar to that which Buridan and Oresme had made in the fourteenth century.

But even as the seventeenth century provides additional instances of imaginary and hypothetical situations derived from the concept of God's absolute power, the mechanical universe which was fashioned in that century heralded the end of divine intervention. The divine possibilities, or natural impossibilities, which played a

rerum," as translated by Walter Emge and Milič Čapek in Milič Čapek, ed., *The Concepts of Space and Time, Their Structure and Their Development* (Dordrecht 1976) 91-92.

¹³⁶ Hobbes (n. 132 above) 1.91.

¹³⁷ Bartholomaeus Amicus (n. 16 above) 2.659 col. 1(B), bk. 4, tract. 20 (*De loco*), dub. 9.

¹³⁸ *Ibid.* 660, col. 1(D).

¹³⁹ Čapek (n. 135 above) 93.

¹⁴⁰ *The Leibniz-Clarke Correspondence*, ed. H. G. Alexander (New York 1956) 32. The bracketed qualification is mine.

significant and interesting role for some four centuries of Western thought terminated with a changed conception of God's power. The God of the Middle Ages, who could do anything he pleased short of a logical contradiction, was replaced by a God of constraint, who, having created a perfect clock-like universe, rested content merely to contemplate his handiwork ever thereafter. The era of possible divine intervention and action, and the imaginative speculations it provoked, had come to an end.

Department of History and Philosophy of Science
Indiana University
Bloomington, Indiana 47401, U.S.A.