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CRITIQUES & CONTENTIONS

The Anglican Origins of Modern Science: The Metaphysical Foundations of the Whig Constitution

By James R. Jacob* and Margaret C. Jacob*

A NEW DIMENSION HAS BEEN ADDED in the last decade or so to conventional accounts of the Scientific Revolution. It is now clear that ideological and social factors proved crucial in the development of science in seventeenth-century England. During this "classical" period both natural philosophy and scientific methodology were shaped in part by their environment. Various historians have demonstrated that the English Revolution, understood as a crisis stretching from the 1640s to the early eighteenth century, bears close relation to the contemporary history of English science.¹ Indeed it may now be said that the Scientific Revolution from Boyle to Newton was one of the most important and subtle transformations to come out of "the century of revolution." Here we shall go further and attempt to specify a precise linkage between the dynamics of the Revolution and the philosophical origins of modern science. This linkage, it will be argued, not only explains the impact of the constitutional struggle upon natural philosophy but accounts for the powerful ideological support that the resulting science supplied after 1689 to the Whig version of the constitution. Science was shaped in the crucible of a more material revolution—a decisive transfer of political and economic power—and scientific ideology itself contributed to the resolution of that political crisis.

Crucial to this process was an intellectual transformation within Anglicanism which began at mid-century and continued throughout much of Newton's lifetime (1642–1727). Out of that transformation primacy of place was given to a particular

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¹Christopher Hill, *The Century of Revolution 1603–1714* (London: Nelson, 1961); the articles by S. F. Mason, H. F. Kearney, Christopher Hill, T. K. Rabb, Barbara Shapiro, and Margaret 'Espinasse that first appeared in *Past & Present*, collected since in Charles Webster, ed., *The Intellectual Revolution of the Seventeenth Century* (London/Boston: Routledge and Kegan Paul, 1974), pp. 197–316, 347–368; P. M. Rattansi, "The Social Interpretation of Science in the Seventeenth Century," in Peter Mathias, ed., *Science and Society 1600–1900* (Cambridge: Cambridge University Press, 1972), pp. 1–32; Margaret C. Jacob, *The Newtonians and the English Revolution 1689–1720* (Ithaca, N.Y.: Cornell University Press, 1976); and J. R. Jacob, *Robert Boyle and the English Revolution* (New York: Burt Franklin, 1977).

kind of science: once again it will become clear that religious factors proved central to the origins of modern science. When new evidence is brought to bear on that perennial question of the relationship between science and religion, a new general thesis emerges concerning the origins of modern science. And once perceived, the Anglican origins of modern science add an entirely new dimension to the history of English constitutional development.

We are not accustomed to thinking of English science as being indebted to Anglicanism. Robert Merton has taught us to think rather of its Puritan origins, and Charles Webster's recent monument to scholarship, *The Great Instauration*, while defining Puritanism much more narrowly than Merton did, gives new life to Merton's thesis.² Webster argues that a major step in the development of English science occurred between 1640 and 1660, and that the motivation for this science came essentially from Puritanism (understood as reformist religion generally, from liberal Anglicans through Presbyterians and Independents to certain sectaries) and specifically from Puritan millenarianism.³ Webster supports his argument with a wealth of detail and his case is convincing as far as it goes. But Webster's is not the last word on the subject, because his work raises a vital question which he never addresses: what happened in the course of the seventeenth century to the reformist science unleashed by the Puritan millennial vision? According to Webster, the Puritan natural philosophers practiced their science in the 1640s and 1650s, but their reforming aims came to an end with the failure of the Revolution and the restoration of the monarchy and established church in 1660. This is not to say that the Puritan savants, Samuel Hartlib and his circle, were without permanent influence. The Royal Society and the Royal College of Physicians appropriated many of their ideas and projects and indeed some of their personnel—Robert Boyle and William Petty, for example. Webster acknowledges this, but he equally maintains that the old motivation was dead: science had ceased to be dedicated to building Jerusalem—a more virtuous, public-spirited, and egalitarian society—and became narrow, elitist, lacking in a social conscience.⁴

Webster's interpretation rests upon the assumption that an almost Manichaean contrast existed between the social aims of Puritan science and the pursuit of organized science after 1660. But history is rarely, if ever, so tidy, and Webster's assumed dichotomy does not stand up under the evidence. Missing in his account is an awareness of the dialectic of the Revolution itself—the fact that it was one thing in 1640–1641 and had become quite another by the 1650s.

Since he presents an essentially one-dimensional revolution Webster creates an impossible quandary: there is simply no way of getting from his Puritan scientists of millennial persuasion to the science of Newton and the Newtonians, to what he calls that “quite different, alien ideology” out of which modern science, that is Newtonian science, evolved.⁵ That Newton and many of his associates were also millenarians, that they shared an intensely religious and social vision of science, that they held to distinct political positions—albeit different from the millenarian, religious and political interests of Puritan scientists during the 1640s—all this is still not enough to

²Robert K. Merton, *Science, Technology and Society in Seventeenth-Century England* (New York: Howard Fertig, 1970); and Charles Webster, *The Great Instauration* (London: Duckworth, 1975). Note the perceptive comments by Benjamin Nelson in Tom Bottomore et al., *Varieties of Political Expression in Sociology* (Chicago: University of Chicago Press, 1972), pp. 202–210.

³Webster, *Great Instauration*, Ch. 1.

⁴*Ibid.*, Ch. 6.

⁵*Ibid.*, p. 250.

enable Webster to see the link between his science and theirs.

What follows reveals the existence of that link and examines its character. The story takes up with the rupture that occurs in the ranks of reforming scientists and savants in the course of the mid-century turmoil. One group, led by Boyle, John Wilkins, John Wallis, Walter Charleton, John Evelyn, Christopher Wren and others, continued to advocate and engage in the organized pursuit of experimental science.⁶ But they dissociated this project from any radical reform of church, state, the economy or society. They did not cease entirely to be reformers, but couched their reforming sentiments in vague terms of improving man's health and estate through science. When they did become more specific, it was, for example, to indicate the ways by which experimental science might be deployed to increase production, especially food production, and commerce.⁷ But these reforms would progress without altering the existing social arrangements in the direction of greater leveling or redistribution of authority. This is not to discount these reforming aims, but to indicate that they would not democratize politics and society.

As if to symbolize this approach to reform, many in this group left revolutionary London and retreated into Oxford colleges away from the social and political turmoil, there to pursue their thoughts in quiet contemplation. And when radicalism threatened to jeopardize their freedom within the University, they stepped in to oppose the radicals.⁸ These conservative reformers made a point of avoiding all religious and political questions while discussing science. This, however, does not mean that they were unaffected by the outside world and did not have their own opinions about it, but rather that their science was not intended to democratize power relations within society.⁹

In this regard the conservative reformers consciously distanced themselves from the radicals who saw in science a powerful tool for promoting religious, political, and social revolution. Science, as they understood it, could justify democracy in church and state; it might also be used to extend popular education in schools and universities and to build a new society that would be more just and rational.¹⁰

In reaction conservative reformers did more than retreat to Oxford; they also developed a metaphysics of God and matter that authorized a conservative interpre-

⁶Robert Boyle, *Some Considerations Touching the Usefulness of Experimental Natural Philosophy*, Pt. I (1663) and Pt. II (1671). Both parts were written during the 1650s: see R. S. Westfall, "Unpublished Boyle Papers Relating to Scientific Method," *Annals of Science*, 1956, 12:65, and Thomas Birch, ed., *The Works of the Honourable Robert Boyle*, 6 vols. (London, 1772), Vol. III, p. 395. For a treatment of Parts I and II see Jacob, Boyle, pp. 104–118 and 141–143 respectively. See also: Charles Webster, "The College of Physicians: 'Solomon's House' in Commonwealth England," *Bulletin of the History of Medicine*, 1967, 41:393–412; J. J. O'Brien, "Commonwealth Schemes for the Advancement of Learning," *British Journal of Educational Studies*, 1968, 16:30–42; and Christopher Wren, *Parentalia: Or Memoirs of the Family of Wrens* (London, 1750), p. 196.

⁷Jacob, Boyle, pp. 141–143, and Royal Society of London, Letter Book Supplement, A–B Copy, John Beale, pp. 348, 382, 389–390, 403–410.

⁸Allen G. Debus, ed., *Science and Education in the Seventeenth Century: The Webster-Ward Debate* (London: Macdonald, 1970); Henry Stubbe, *A Light Shining Out of Darkness* (London, 1659), which was "answered by H. F. [Henry Ferne?] but never printed," according to Anthony à Wood, *The History and Antiquities of the University of Oxford*, 3 vols. (Oxford, 1792–1796), Vol. III, p. 695; for the conservative reaction to Stubbe's attack on conventional religion and the universities: Anthony à Wood, *Athenae Oxoniensis*, ed. P. Bliss, 4 vols. (London, 1813–1820), Vol. III, p. 1069. See also: *Sundry Things from Several Hands Concerning the University of Oxford* (London, 1659), and Charles Webster, "William Dell and the Idea of University," in *Changing Perspectives in the History of Science*, ed. Mikuláš Teich and Robert Young (London: Heinemann, 1973), pp. 110–126.

⁹J. R. Jacob and M. C. Jacob, "Scientists and Society: The Saints Preserved," *Journal of European Studies*, 1971, 1:87–90; and J. R. Jacob and M. C. Jacob, "Seventeenth Century Science and Religion: The State of the Argument," *History of Science*, 1976, 14:200–201.

¹⁰Christopher Hill, *The World Turned Upside Down* (London: Temple Smith, 1972), Ch. 14.

tation of the social hierarchy and answered the radicals by rendering their social views untrue in terms of the conservative metaphysics. In other words, a conservative matter theory was constructed which "outlawed" radicalism from the universe. We shall argue that this new metaphysics, produced for ideological reasons by conservative reformers in their dialogue with the radicals, had a profound effect upon the development of modern science. By examining the social process by which this new matter theory developed, we shall establish the connection of which Webster's thesis cannot take account, the connection between reforming Puritan science in the 1640s and 1650s and the development of theoretical science—especially mathematical physics and astronomy after the Restoration, most importantly in the work and achievement of Isaac Newton. There is a clear, straight line running between the conservative reformers of the mid-century revolution and the Newtonian synthesis, and this line allows us to chart "the Anglican origins of modern science."

Let us also be clear that this is not another restatement of the Merton thesis. He, like Webster, took no account of the dialectics of the Puritan revolution and the resulting dialogue between conservatives and radicals. More to the point, Merton did not address himself to the connections between Puritanism and scientific theory but only to those between Puritanism and scientific practice.¹¹ Yet it is only on the level of the former connections between religious ideology and matter theory that we can trace the social genesis of the conceptual revolution that culminated in the Newtonian synthesis, the hallmark of the Scientific Revolution. To this process we now turn.

* * *

True, the Revolution did unleash Puritan reformism, and this impulse was translated by Hartlib's group into a melioristic scientific enterprise. But the Revolution unleashed more than that. From the mid-1640s and up to the moment the king was restored, England was swept by waves of social radicalism unmatched by anything before or since. If the radicals had won the day the world would have been (in the words of the foremost historian of the subject) "turned upside down."¹² Various radical groups advocated such changes as disestablishment of the church and abolition of tithes, lay preaching, equality of women, sexual libertinism, and extension of the franchise and property redistribution.

The radical sects supported their attacks on church and state with an antinomian theology deriving from the Reformation revival of ancient heresies. In its most extreme form—in the hands of Digger Gerrard Winstanley for instance—this ideology ended in mortalism and a pantheistic materialism that, denying the distinction between Creator and creation, asserted that divinity lay not in a transcendent supernatural realm but in the here and now, the world of man and nature.¹³ Important in the present context is that a fundamental belief of all radicals was that

¹¹M. D. King, "Reason, Tradition and the Progressiveness of Science," *History and Theory*, 1970, 10:5–21.

¹²Hill, *World Upside Down*. The notion of turning the world upside down was a popular commonplace. See Peter Burke, *Popular Culture in Early Modern Europe* (London: Temple Smith, 1978), pp. 188–189.

¹³Hill, *World Upside Down*, pp. 112, 114, 150, 176, 318–319; Christopher Hill, ed., *Winstanley: The Law of Freedom and Other Writings* (Harmondsworth: Penguin, 1973), pp. 42–59. For Winstanley as theist and pantheist as against Hill's Winstanley as pantheist only, see Lotte Mulligan, John Graham, and Judith Richards, "Winstanley: A Case for the Man as He Said He Was," *Journal of Ecclesiastical History*, 1977, 28:57–75.

the holy spirit was directly accessible to or even in man; the rigid dualism between matter and spirit, the fallen world and the perfect God, of orthodox Christianity was at least blurred, if not altogether obliterated.¹⁴

The spread and tenacity of this "enthusiasm" (to use the pejorative that lumped all radicals under one categorical umbrella) alarmed more conservative thinkers, including those who had participated in the scientific movement sponsored by reformist Puritans. In other words, there is a discernible and crucial difference between the reformism of the Hartlibians, of Boyle, Benjamin Worsley, and Petty, and the radicalism of Seekers, True Levellers, Fifth Monarchists, Ranters, and Quakers. Both groups, reformists and radicals alike, belonged to the revolution, but by 1650 the revolution of the radicals had left the reformists far behind.

The radical sectaries were drawn to alchemy, astrology, and number mysticism because these occult sciences fitted their conception of a vitalistic or in some extreme cases even pantheistic universe alive with spirit. According to the radicals, if man could learn to read nature, he could master it and hence attain to perfect wisdom and its attendant blessings. The reformation of the world would be complete and men could then enjoy a millennial paradise on earth.¹⁵ In the early 1640s Puritan reformers like Boyle had also adopted a millennial scheme based upon notions of the reformation of the world and of knowledge which were derived from the works of Francis Bacon and Jan Comenius. Expectation ran high in the heady early years of the Revolution, and the Puritan philosophers even developed an intense interest in the occult sciences as keys to the mastery of nature.¹⁶ But in the late 1640s the reformers retreated from this extreme position, as the radical sectaries appropriated it to their own purposes and spun out the heretical and subversive implications of occult science and its vitalistic conception of the universe.¹⁷

During the 1650s the reformers—Boyle, Walter Charleton, and others—modified their philosophy in the face of the radical threat: in the place of the now discredited occultism they adopted what Boyle called the corpuscular philosophy. This amounted to a Christianized Epicurean atomism treated as a hypothesis to be tested by experiment. The corpuscularians held with Epicurus that the world was made up of lifeless atoms colliding in the vacuum of space. But the Puritan philosophers departed from Epicurus by denying that the world as we know it was the product of a long succession of random atomic collisions. Rather they held that a providential God was responsible for all motion in the universe. He determined the paths the atoms took and hence maintained the order of the universe.¹⁸ Not only was this a workable scientific hypothesis capable of being refined and elaborated by a Baconian program of experiment, it was also an attractive candidate for adoption because it was applicable to social issues.

¹⁴Geoffrey Nuttall, *The Holy Spirit in Puritan Faith and Experience* (Oxford: B. Blackwell, 1946); Winthrop S. Hudson, "Mystical Religion in the Puritan Commonwealth," *Journal of Religion*, 1948, 28:51–56; James Maclear, "The Making of the Lay Tradition," *Journ. Rel.*, 1953, 33:113–136; and Clair Cross, *Church and People 1450–1660* (Glasgow: Collins, 1976), Ch. 9.

¹⁵Hill, *World Upside Down*, Ch. 14; and Jacob, *Boyle*, pp. 96–128. Cf. Bernard Capp, *English Almanacs 1500–1800* (Ithaca, N.Y.: Cornell University Press, 1979), p. 39.

¹⁶Rattansi, "Social Interpretation of Science," p. 20.

¹⁷*Ibid.*, pp. 20–23; P. M. Rattansi, "Paracelsus and the Puritan Revolution," *Ambix*, 1964, 11:24–32; Jacob, *Boyle*, Ch. 3.

¹⁸Marie Boas, *Robert Boyle and Seventeenth-Century Chemistry* (Cambridge: Cambridge University Press, 1958); Robert H. Kargon, *Atomism in England from Harriot to Newton* (Oxford: Clarendon Press, 1966), pp. 93–105.

This Christianized corpuscular and experimental philosophy allowed the Puritan scientists to escape the taint of heresy associated with the occultism and animism of the radical sectaries. More important, it allowed the reformers to attack the radicals. The idea that matter is moved mechanically by the will and according to the intelligence of a supernatural God upheld the orthodox Christian dualism of matter and spirit in the face of the radicals' animism, their belief that all matter was endowed with soul and that spirit was immanent in nature.¹⁹ Nor was this merely a victory against false theological doctrine; it also had religious and political ramifications. The vitalistic or pantheistic idea of nature provided the metaphysical grounds for an attack on traditional authority in church and state. If spirit lay within man and nature, this was a strong argument against organized churches that were supported by tithes and learned ministries that claimed superior spiritual wisdom and separate spiritual authority—the power to teach, discipline, and punish.²⁰ Vitalism could also be used to support the notion of human equality and to justify in cosmic terms anti-monarchical and even democratic political ideas. The natural philosophy of the radicals tended to dissolve hierarchy, while hierarchical social order found support in the Christian dualism newly shored up by the corpuscular philosophy of the reforming Puritans.²¹

The inductive or experimental aspect of the new corpuscular philosophy worked out in the 1650s also bore an ideological message meant to counter the radicals. Scientific progress would come through painstaking inquiry, the collection of evidence, and the testing of hypotheses. Knowledge then was not, as the sectaries with their emphasis on magic and the occult maintained, the result of mystical experience or God's direct revelation to the saints.²² God instead revealed Himself indirectly by two means, nature and Scripture, His word and His work, and both required close study in order to bear fruit. This emphasis upon patient, industrious scrutiny was directed against the antinomian theology of the radical sectaries, which insisted that God revealed Himself immediately to the saints so that they might achieve perfection or at least perfect wisdom in this life. The fruits of salvation were accessible here and now as well as in the world to come. For the Puritan reformers, on the other hand, the effortless pleasures of salvation were deferred to the next life; in this life rewards would come only through reason and industry.²³ Science, the new philosophy, was the model: knowledge would come not through visions or divine illumination but rather through a searching and sustained inquiry into nature, the humility and dedication of the experimental philosopher. Nor was this update on the work ethic only directed against the illuminism of the sectaries; it was also seen as an instrument of social control. As Boyle insisted, hard work would keep men too busy to contrive heresy or to plot social revolution.²⁴ Science would be particularly valuable in this regard too because the practical application of its discoveries would create more and more employment.²⁵ Both the corpuscularianism and the experimentalism of the

¹⁹Jacob, *Boyle*, pp. 112–115.

²⁰Thomas Edwards, *Gangraena*, 3rd ed. (London, 1646), Division I, Pt. I, pp. 25–26; Hill, *World Upside Down*, Ch. 6.

²¹Edwards, *Gangraena*, pp. 15–19, 23–24, 28–29; Jacob, *Boyle*, Chs. 3 and 4; and Jacob, *Newtonians*, Ch. 1.

²²Jacob, *Boyle*, pp. 98–112.

²³*Ibid.*, pp. 85–88.

²⁴Peter Pett, *A Discourse Concerning Liberty of Conscience* (London, 1661), p. 9. This was a tract commissioned by Boyle and representative of his views (Jacob, *Boyle*, p. 134).

²⁵Thomas Sprat, *A History of the Royal Society* (London, 1667), pp. 343, 400, 408, 426–429.

reforming philosophers were designed to combat two threats, heresy and social insubordination, at the same time.

The new corpuscular philosophy was also meant to answer one particularly virulent version of philosophical and religious heresy: Hobbes's *Leviathan*. Hobbes himself was anything but a radical, but his peculiar conservatism was pitched on the most radical philosophical and theological grounds, which from the 1650s on often resembled the political and religious views of men much more radical than he. In politics Hobbes put forth a persuasive argument for political obligation that rested entirely on considerations of power and self-interest and denied the force of arguments from divine right, providence, or traditional Christian morality.²⁶ As for religion, his mechanistic metaphysics denied the existence of spirit and a spiritual world and hence any independent role to the clergy, who were traditionally seen as the guardians and interpreters of the operations of spirit in the world. The clergy, according to Hobbes, were fraudulent as intermediaries between God and man and should be reduced to mere functionaries of the civil sovereign.²⁷ From the point of view of the Puritan natural philosophers Hobbes sucked too much spirit out of the world, while the sectaries pumped too much back in.

The reforming Puritan savants deployed their corpuscular philosophy against Hobbes and Hobbesists, just as they did against antinomians and other radicals. Indeed after 1660 Hobbesism was increasingly identified with subversion²⁸—and with good reason, as we shall see. Corpuscularianism preserved a role for spirit in the universe, namely, that of imparting motion to matter and giving shape to the world through providential design. Hence the corpuscularians, against Hobbes's radical surgery, supported the clergy's authority as interpreters of God's ways and will.²⁹ The experimentalism of the Puritan savants was also aimed against Hobbes: the way to knowledge was through induction and the testing of hypotheses, not through Hobbes's deductive rationalism any more than through the saints' illuminism.³⁰

Under the impact of radical sectarian and Hobbesist challenges the Puritan philosophers grafted their reforming science onto an ideology that sought to reestablish order and stability in church and state. Science was not only seen to alleviate man's material condition; it also might cure the excesses of revolution. The natural philosophers who created the new ideology of science, like Boyle, Wilkins, and Charleton, kept the reforming aims of the Puritan scientific vision, particularly when they were easily accommodated to or even promoted the larger political and religious goal. So they continued to argue for science as a means to greater private profit and national wealth and power, because science, to the extent that it increased agricultural production, trade, and shipping, would also foster domestic peace. The scientific

²⁶Besides Hobbes, *Leviathan* (London, 1651), Pt. I, see Quentin Skinner, "The Ideological Context of Hobbes's Political Thought," *The Historical Journal*, 1966, 9:286–317, where it is shown that views similar to Hobbes's regarding obligation were widely held at the time *Leviathan* first appeared.

²⁷Hobbes, *Leviathan*, Ch. 42.

²⁸[Thomas Tenison], "The Epistle Dedicatory," *The Creed of Mr. Hobbes Examined* (London, 1671), pp. 7–8, 13–15; Joseph Glanvill, *A Blow at Modern Sadducism* (London, 1668), pp. 153–160; John Evelyn, *The History of Religion*, ed. R. M. Evanson, 2 vols. (London, 1850), Vol. I, pp. xxvii–xxviii; and J. R. Jacob, "Civil Religion and Radical Politics: Stubbe to Blount," read at the 1978 American Historical Association Annual Meeting in San Francisco.

²⁹John Wallis to John Owen, Oct. 10, 1655, in Peter Toon, ed., *The Correspondence of John Owen (1616–1683)*, (Cambridge: Cambridge University Press, 1970), pp. 87–88; John Wallis, *Hobbiani Puncti Dispunctio* (Oxford, 1657), pp. 42–43; and Robert Boyle, "The Preface," *An Examen of Mr. T. Hobbes His Dialogus Physicus de Natura Aeris* (Oxford, 1662).

³⁰Boyle, "The Preface," *An Examen*; and John Wallis, "The Epistle Dedicatory," *Elenchus Geometriae Hobbiana* (Oxford, 1655).

protagonists equated a science made practical with growing prosperity, social order, and the public good.³¹

The initial Puritan reforming vision of the 1640s thus survived in a continuing belief in the material benefits of science.³² By the late 1650s, however, this belief in science as an instrument of material progress was wedded to a new Anglican theology, one no longer essentially Puritan but latitudinarian. Its central tenets were repudiation of predestination, a concomitant emphasis on free will and striving as the keys to salvation, and an almost obsessive concern for design, order, and harmony as the primary manifestations of God's role in the universe.³³ Evolved during the 1650s, this liberal Anglicanism relied upon the new science to verify both God's order in an unstable world and the superiority of cautious scientific inquiry to the illuminations of the spirit. During the Cromwellian Protectorate the hope among men like Boyle and Richard Baxter was that this view could be translated into a church settlement based upon Archbishop James Usher's schemes for moderate episcopacy.³⁴ These hopes of course were never realized, but they survived the Restoration, and this scientifically grounded latitudinarianism received its classic formulations in the works of Robert Boyle published after 1660 and in Thomas Sprat's *History of the Royal Society* (1667), masterminded by John Wilkins. It was thus adopted as the public stance, if not the official ideology, of the Royal Society.³⁵

Barbara Shapiro has argued against Merton and the Mertonians that to the extent that the early fellows of the Royal Society shared a common outlook it was latitudinarian. According to Shapiro, science itself or scientific humanism was the shaping force in the development of latitudinarianism, and she attributes little or no influence in this regard to the radical revolution and the latitudinarian responses to it.³⁶ We would argue in contrast, on the basis of what we now know, that this new Anglicanism with its supportive science and natural philosophy was crucially defined by the dialectics of revolution, by the challenges posed by the radical sectaries and the reforming Puritan response to them. With Webster we would agree that in 1640 the initial scientific vision was Puritan (although we would not agree with him that it was killed off rather than developing into something else); with Shapiro we would agree that by 1660 this vision had become latitudinarian (although we would not agree with her that it had never been Puritan). Yet against both Webster and Shapiro it must be asserted that Puritanism was transformed into liberal Anglicanism during and because of the Revolution. In that transformation lie the Anglican origins of modern

³¹Wren, *Parentalia*, p. 196; and Royal Society, Letter Book Supplement, A-B Copy, Beale, pp. 348, 382, 389–390, 403, 410. For a suggestive approach to politics and economic ideology in this period see Joyce Appleby, *Economic Thought and Ideology in Seventeenth Century England* (Princeton: Princeton University Press, 1978), Ch. 9.

³²Jacob, *Boyle*, pp. 133–159.

³³See Robert Martin Krapp, *Liberal Anglicanism: 1636–1647* (Ridgefield, Conn.: Acorn Press, 1944); John F. H. New, *Anglican and Puritan: The Basis of Their Opposition, 1558–1640* (Stanford/London: Stanford University Press, 1964), pp. 16–21; for further evidence of preaching against predestination in Cambridge during the 1650s, see Spencer Research Library, University of Kansas, diary of Charles North, MS A. 41, fol. 1, Dr. Cudworth of Clare Hall “On 4 Esiah: 5;” also Dr. Arrowsmith, and Dr. Love on the theme “faith without good works is dead.” Cf. Gregory Memorandum, Gregory MSS, University Library, Edinburgh, DC. 1. 61, fol. 93, “When Dr Duport resigned the chair of Greek he recommended his pupil Mr. Barrow who . . . being suspected of Arminianism he could not obtain it and therefore in 1654 he . . . went first to France in Paris he found his father attending the English Court. . . .”

³⁴G. R. Abernathy, “Richard Baxter and the Cromwellian Church,” *Huntington Library Quarterly*, 1961, 24:227–231; and Jacob, *Boyle*, pp. 118–126.

³⁵Jacob, *Boyle*, pp. 133–143, 152–159.

³⁶Barbara Shapiro, *John Wilkins 1614–1672* (Berkeley/Los Angeles: University of California Press, 1969), pp. 1–11, 224–250.

science and the ideological continuity of English science from Boyle to Newton.

That continuity is everywhere apparent, in the rhetoric of private philosophizing as well as in public ideology. The articulation of this new Anglicanism received philosophical refinement in Restoration Cambridge, where a new generation of natural philosophers, Platonists as they were called, labored to create a metaphysics of spirit that would prove compatible with the new science and yet repudiate "enthusiastic" sectarianism. Henry More and Ralph Cudworth, although in no sense experimentalists like Boyle and his associates (and hence sometimes in disagreement with them), nevertheless embraced the primacy of spirit over matter, of Creator over creation, so central to the new corpuscularian philosophy. For a time More looked to the mechanical philosophy of Descartes as an alternative to the pantheism of the sects and the materialism of Hobbes. Eventually he discarded Descartes, too, because his radical separation of matter and spirit created an intellectual gap through which the heresies of the sects and the mechanisms of Hobbes might creep once again.³⁷

The Cambridge Platonists, and More in particular, like the Puritan reformers, saw this struggle with heresy in historical and cosmic terms; they too were millenarians. Millenarianism flourished in the private world of college tutorials; it was now understood to be too dangerous a doctrine for pulpit orations. Within Anglican circles the quiet purveyors of prophecy can often be traced to Cambridge: Isaac Newton, John Worthington, Thomas Burnet, Drue Cressener, Simon Patrick, Edward Fowler, John Tillotson, and Thomas Tenison—all to varying degrees displayed apocalyptic sentiments at moments of political anxiety or were given to full-blown millenarian predictions.

The millennium of the Restoration latitudinarians did display certain marked differences from that of the Puritan reformers: it was largely a private matter, self-consciously aimed against, as Evelyn put it, "the Millenaries of old, or Fifth Monarchists of Late," it entailed no amelioration of existing social inequities, and invariably it gained expression at moments of political crisis—the prospect or reality of Catholic monarchy, the revolution of 1688–1689, the wars against France. It too applied scientific theories to social conditions. Anglican millenarianism posited a preordained harmony and order, imposed by God on nature, enforced by the established church and monarchical state on society. And in the case of Newton millenarianism may have led to speculations about the "irregularities . . . which may have arisen from the mutual actions of comets or planets upon one another, and which will be apt to increase till this system wants a reformation."³⁸

By and large Anglican millenarianism, that particular "civic consciousness" of its latitudinarian wing, remained well beneath the surface after 1660 and even, although for different reasons, after 1689. Liberal Anglicans of the Restoration had to tread carefully; they got and indeed sought few enough preferments from the recently restored hierarchy, which was bent upon dissociating itself from those who had

³⁷Charles Webster, "Henry More and Descartes: Some New Sources," *British Journal for the History of Science*, 1969, 4:359–364; Marjorie Nicolson, "The Early Stages of Cartesianism in England," *Studies in Philology*, 1929, 26:356–374; Sterling P. Lamprecht, "The Role of Descartes in Seventeenth Century England," Columbia University, *Studies in the History of Ideas*, 1935, 3:181–242. We are not implying that the rejection of Descartes can be explained solely along social and religious lines; cf. Kargon, *Atomism in England*.

³⁸Isaac Newton, *Opticks* (London, 1717–1718), p. 378. Cf. David Kubrin, "Providence and the Mechanical Philosophy: The Creation and Dissolution of the World in Newtonian Thought" (Ph.D. diss., Cornell University, 1968); and Margaret C. Jacob, "Newton and the French Prophets: New Evidence," *History of Science*, 1978, 16:134–142.

compromised with the Interregnum and punishing them. For a young man with an instinctively cautious temperament, such as Newton, the mood of the times demanded that he get on with intellectual pursuits and leave prophecy and polemic buried in private manuscripts and notebooks; for churchmen with decided political views and interests, caution became an acquired trait.

The Puritan philosophers were trimmers. They trimmed during the 1650s when they sought the resettlement of the church along latitudinarian lines that would incorporate Anglicans and Presbyterians in one communion, tolerate mild dissent, and discipline sectarian extremists.³⁹ They trimmed again during the Restoration, when that broad church was not forthcoming, and decided to work within the Anglican establishment and to pitch their science on theological grounds that were latitudinarian but nonetheless Anglican.⁴⁰ As their sermons reveal, this trimming, so consistent from the 1650s right through the Revolution of 1688–1689, was sustained by two hopes: the prospect that science would bring wealth and power (not to speak of the goods it had already delivered) and the desire first to obtain and then to preserve order and stability, an environment in which the profitable pursuit of science could take place, against threats of subversion from below and, at least during the Restoration, by Catholics from outside.⁴¹

Yet trimming did not mean retreat from polemical involvement with the church's enemies. After 1660 church and monarchy had been rendered secure against varieties of political and intellectual radicalism that doggedly persisted despite the new mechanisms for suppression. Although the radical sectaries were forced underground after the Restoration, and consequently their history largely obliterated, there were significant eruptions that reveal what happened. In particular the activities and writings of that most infamous Restoration heretic and subversive, Henry Stubbe, tie the 1650s to the 1670s and beyond.

A radical Independent in the 1650s, Stubbe has been conventionally seen as a turncoat upholder of the status quo after the Restoration. His famous attacks on the Royal Society have been read by such noted authorities as Richard Foster Jones and Herschel Baker as a conservative defense of the traditional Aristotelian learning against the incursions of the new philosophy of the Royal Society.⁴² A defense of traditional learning these attacks may have been, but what has until now been missed is the radical aim underlying them. Stubbe's brief was not against the science of the Royal Society but rather against its natural religion. He was the first to see the ideological implications of its position: it upheld traditional religion—belief in a providential God and a clergy delegated to justify His ways to man. This was too much for Stubbe the radical Hobbesian.⁴³ Indeed it was tantamount to popery.⁴⁴ Stubbe instead advocated a return to what he believed to be purest Christianity—a simple Arian creed denying the divinity of Christ, toleration of opinion beyond that,

³⁹See note 33.

⁴⁰Jacob, *Newtonians*, Ch. 1.

⁴¹Jacob, *Boyle*, pp. 159–176; and J. R. Jacob, "Boyle's Atomism and the Restoration Assault on Pagan Naturalism," *Social Studies of Science*, 1978, 8:211–233.

⁴²Richard Foster Jones, *Ancients and Moderns*, 2nd ed. (St. Louis, Mo.: Washington University Press, 1961), pp. 244–262; and Herschel Baker, *The Wars of Truth* (Cambridge: Harvard University Press, 1947), pp. 362–365.

⁴³British Library Add. MS 32553, fols. 5–34; Francis Thompson, "Lettres de Stubbe à Hobbes," *Archives de Philosophie*, 1936, 12:99–106; Henry Stubbe, *The Miraculous Conformist* (London, 1666), pp. 2, 4–6, 10–11, 27; Royal Society, *Boyle Letters* 2, fol. 65v; Henry Stubbe, "The Preface to the Judicious Reader," *Legends No Histories* (London, 1670), (the third unnumbered page); Joseph Glanvill, *A Praefatory Answer to Mr. Henry Stubbe* (London, 1671), Preface (first unnumbered page), pp. 6, 11, 63.

⁴⁴Henry Stubbe, *The Plus Ultra Reduced to a Non Plus* (London, 1670), p. 12.

and a church in which the civil authority possessed complete control and the clergy, assuming there was any, was thus stripped of any independent spiritual authority.⁴⁵ Stubbe's ecclesiology, moreover, rested on a vitalistic materialism, equally applicable to the world of man and nature, reminiscent of Winstanley.⁴⁶ Stubbe spread his ideas underground through an important and until now ignored manuscript.⁴⁷ He also probably preached his extreme Erastianism—arguing state supremacy in ecclesiastical matters—or what he liked to call “Mahometan Christianity” to Dissenters in rural Somerset, Bath and Bristol.⁴⁸ Stubbe, moreover, was not a voice in the Restoration wilderness. His and similar ideas were current in radical Whig circles during the Exclusion crisis and were published by Charles Blount after the Revolution of 1688–1689.⁴⁹

Nor were Stubbe and latter-day Whiggish Stubbians ignored by the natural philosophers of the Royal Society. Robert Boyle and his circle were in active and continuous dialogue with Stubbe and with varieties of philosophical heresy throughout the Restoration.⁵⁰ Boyle in public and Newton in private, to name only the two leading philosophers, continued to define their own metaphysics in response to the threat posed by what Newton called atheism and Boyle preferred to label naturalism—the philosophies of Hobbes, Stubbe, and their ilk. Boyle's imagination ran wild. He and his Anglican associates, John Evelyn and John Tillotson among others, powerful churchmen all, feared that should the king grant a declaration of indulgence in 1686, sectaries would unite with papists to undo the Reformation in England.⁵¹ Fortunately for them the Revolution of 1688 removed the Catholic menace, but the radicals were still on hand—indeed, as we shall see, with renewed vigor.

While Boyle and Glanvill pounded at the naturalists in print, More and Cudworth in Cambridge worked out a variety of attacks against Hobbesism, enthusiasm, and the new spectre of Spinoza's pantheism. Newton's unpublished writings echo this same polemical rhetoric. His private manuscripts and notebooks from the 1660s, the period wherein he formulated the metaphysical positions at the foundations of his science, and ones that stayed with him until his death, reveal his millenarianism. Most important, they make use of rhetorical formulations of natural philosophy directly relevant to the ideology of the new Anglicanism. Shortly after Newton's death, his associate John Craig, who many years earlier had been the intermediary between Newton and Richard Bentley, wrote that the reason for Newton's “showing the error of Cartes' Philosophy, was because he thought it was made on purpose to be the foundation of infidelity.”⁵²

A close reading of Newton's earliest manuscripts confirms Craig's view: the

⁴⁵Henry Stubbe, *An Account of the Rise and Progress of Mahometanism*, ed. Hafiz Mahmud Khan Shairani (London, 1911), passim; and Glanvill, *Praefatory Answer*, pp. 62–63. For Stubbe's authorship see J. R. Jacob, “The Authorship of *An Account of the Rise and Progress of Mahometanism*,” *Notes & Queries*, 1979, N. S. 26:10–11.

⁴⁶See note 43 above and *Account of Mahometanism*, p. 49.

⁴⁷*Account of Mahometanism*; J. R. Jacob, “Civil Religion and Radical Politics: Stubbe to Toland,” book in preparation; J. R. Jacob, “Aristotle and the New Philosophy: Stubbe v. the Royal Society,” in M. Hanen et al., eds., *Science, Pseudoscience and Society* (Waterloo, Ontario: Wilfrid Laurier University Press, 1980), in press.

⁴⁸Glanvill, *Praefatory Answer*, pp. 62–63; and Jacob, “Civil Religion.”

⁴⁹Cf. Charles Blount et al., *The Oracles of Reason* (London, 1693), pp. 156–165 and 98–104, and *Account of Mahometanism*, pp. 2–7 and 42–46 respectively.

⁵⁰Jacob, “Boyle's Atomism and Pagan Naturalism,” passim.

⁵¹*Ibid.*, pp. 224–228.

⁵²John Craig to John Conduitt, Apr. 7, 1727, Cambridge University Library MSS Add. 4007 fol. 686.

language he employed was remarkably similar to the Anglican polemics with which he was surrounded. Newton repudiates Descartes's definition of body as extension because it does "manifestly offer a path to Atheism";⁵³ likewise he repudiates "the vulgar notion (or rather lack of it) of body . . . in which all the qualities of the bodies are inherent" because it too leads directly to atheism. Newton, like Boyle at the very same time, wanted to construct an alternative to Aristotelian ("vulgar") matter theory because its implications were heretical and specifically because they chimed with the vitalistic and pantheistic notions of "the vulgar," spawned by the radical sectaries during the Revolution. As Newton says in his manuscript, "Indeed however we cast about we find almost no other reason for atheism than this notion of bodies having, as it were, a complete, absolute and independent reality in themselves."⁵⁴ In short Newton saw a profound danger in the spectre of atheism whether in the mechanistic version he read Descartes to be supporting, or in the "vulgar" form that denied differences in substance between mind and body, in effect denying "that God exists, and has created bodies in empty space out of nothing. . . ." The basic definitions of Newtonian natural philosophy are clearly present in those early manuscripts: the power of divine will to move "brute and stupid" matter, the independent, absolute existence of space and time, and, most essential to the formulation of the concept of universal gravitation, the notion that "force is the causal principle of motion and rest"⁵⁵ which operates on bodies *in vacuo*. Cambridge in the 1660s was not ideologically remote from the London of the Royal Society.

By the late 1680s the threat posed to the established church came not from West Country Whigs but from the monarchy itself. Liberal Anglicans had been of one voice in their opposition to Catholicism, yet they had been equally loyal to the institution of monarchy. Where we find Royal Society pamphleteers active during the Exclusion crisis, they were allied to the Tories.⁵⁶ An aggressively Catholic monarch who inherited a court culture that was suspiciously Epicurean (and in his brother's day notoriously libertine) posed a delicate, almost insoluble, quandary.

In the light of that quandary, and of what we now know about the political activity of the Royal Society during the Restoration, we wish to propose a new approach to the timing of the publication of Newton's *Principia* (1687). Our evidence is circumstantial to be sure, but it is worth considering. First let us recount the standard story, how Edmond Halley, who in the early 1680s was on good terms with both John Tillotson and the Royal Society, prodded the reticent and otherwise preoccupied Newton into writing and publishing his magnum opus. Throughout the 1680s, it should be noted, Newton seems to have been particularly preoccupied with the rise and fall of ancient monarchies and with the apocalyptic texts of the Old and New Testament.⁵⁷ But Halley persuaded him to leave his historical and alchemical studies when he brought news about debates in London on the phenomenon of universal gravitation. The result of that digression was of course the *Principia*. It bore on its title page the imprimatur of the Royal Society as well as the name of Samuel Pepys in bold type.

⁵³"De Gravitatione et aequipondo fluidorum," in A. Rupert Hall and Marie Boas Hall, eds., *Unpublished Scientific Papers of Isaac Newton* (Cambridge: Cambridge University Press, 1962), pp. 142–143.

⁵⁴*Ibid.*, p. 144.

⁵⁵*Ibid.*, p. 148.

⁵⁶J. R. Jacob, "Restoration Ideologies and the Royal Society," *Hist. Sci.*, Feb. 1980, 18.

⁵⁷Frank E. Manuel, *The Religion of Isaac Newton. The Fremantle Lectures, 1973* (Oxford: Clarendon Press, 1974), pp. 99–100, and, for portions of Yahuda MS 1 by Newton, Appendix; Manuel, *Isaac Newton, Historian* (Cambridge: Cambridge University Press, 1963), pp. 1–17.

Pepys's trimming at the court of James II was well known, and indeed he paid dearly for it in the post-1689 political wilderness to which he was consigned.

The difficulty with the Halley-Newton story, attractive though it is, is that it also closely resembles George Ent's description of his role in prodding William Harvey to allow his *De generatione animalium* to be published in 1651.⁵⁸ That of course does not make the story untrue in the case of Newton. But if there is something to the hypothesis that the publication of Newton's *Principia* during the reign of James II was inspired by political motives, whether Newton knew of them or not, we would expect some oblique indication of that covert design, some hint dropped either in Halley's admiring ode on Newton and his achievement prefixed to the *Principia*, or possibly in Halley's fawning and explanatory letter on that achievement addressed to James II and later published in the *Philosophical Transactions*.⁵⁹

A new translation of Halley's ode, which relates it directly to Lucretius' *De rerum natura*, has been most usefully supplied by W. R. Albury. That ode begins by reminding the *Principia*'s readers that "the pattern of the Heavens" is based upon "Laws which the all-producing Creator, when he was fashioning the first-beginnings of things, wished not to violate and established as the foundations of his eternal work." After this brief mention of the eternality of Law and the role of the Divine Monarch as its creator and preserver, the poem goes on to glory in the power unleashed by Newton's intellect, which "has allowed us to penetrate the dwellings of the Gods and to scale the heights of Heaven." Couched entirely in Epicurean language, Halley's ode commends the new science sponsored by the Royal Society as the means by which "we are truly admitted as table-guests of the Gods. . . ."⁶⁰ We would agree with Albury's conclusion that the explanation for Halley's choice of Lucretius as his model must lie in his attempt to "reply to Epicurean criticism of the Royal Society" which had circulated in court circles during the 1680s. In short Halley is trying "to convince the fashionable Epicureans associated with the Stuart Court of the importance of Newtonian science,"⁶¹ and this at an absolutely critical time for Anglican natural philosophers and churchmen who had been systematically excluded from James's court.

Perhaps we can now better understand why, after the church's hegemony had been reestablished in the early 1690s, Newton wrote a seemingly bizarre letter to Pepys in which he asserts, almost hysterically, "I never designed to get anything by your interest, nor by King James's favour. . . ."⁶² If indeed the *Principia* had been published in an attempt to be ingratiating, by reestablishing the supportive role that scientific knowledge had given the monarchy during the Restoration, then either Newton was innocent of these motives, or he became almost paranoid after the

⁵⁸Christopher Hill, "Sir Isaac Newton and His Society," in his *Change and Continuity in 17th Century England* (London: Weidenfeld and Nicholson, 1974), p. 274; cf. George Grinnell, "Newton's *Principia* as Whig Propaganda," in Paul Fritz and David Williams, eds., *City and Society in the 18th Century* (Toronto: Hakkert, 1973); pp. 181-192, which at least raises the issue of political motives, although we do not agree with Grinnell's conclusions.

⁵⁹On Halley and James II, see I. Bernard Cohen and Robert E. Schofield, *Isaac Newton's Papers and Letters on Natural Philosophy* (Cambridge: Harvard University Press, 1958), pp. 397-424; on Halley and Tillotson, British Library MSS Add. 17017, fols. 143, 145-146; MSS Add. 4236, fols. 230, 233, 227.

⁶⁰W. R. Albury, "Halley's Ode on the *Principia* of Newton and the Epicurean Revival in England," *Journal of the History of Ideas*, 1978, 39:27.

⁶¹*Ibid.*, pp. 36-37.

⁶²H. W. Turnbull, ed., *The Correspondence of Isaac Newton*, Vol. III (Cambridge: Cambridge University Press, 1961), p. 279.

Revolution in his concern that his name not be associated with Pepys, who was by that time suspected of Jacobitism.

If Newton was naive in 1686, he was not so by 1692. He had led the anti-Catholic opposition to James II in Cambridge and had given his assent to the Revolution of 1688–1689. He urged his parliamentary constituents to do likewise.⁶³ But the Revolution undid more than the Stuarts. It secured the church's constitutional place, yet vastly weakened its legal and moral authority. The latitudinarian faction had now ascended to positions of leadership within the church's hierarchy, and its problems had become theirs.

In the period after 1689 Newton's natural philosophy served as the underpinning for the social ideology preached by the church in response to the Revolution settlement. The Newtonians once again resumed the polemical assault against intellectual and political radicalism, and they did so in language characteristic of Restoration Anglican science. They spoke, fittingly, from the podium established by Boyle's last will and testament (1691). With Newton's assistance and approval the Boyle lecturers, Richard Bentley, Samuel Clarke, William Whiston, and William Derham, brought Newton's "system of the world" to bear against the radical Whigs of the 1690s and beyond, those whose heterodox religion of nature owed much to their reading of Hobbes and Spinoza as well as to Bruno and Servetus, to the extreme pagan naturalism of the late Renaissance.⁶⁴ Indeed the Boyle lecturers did precisely what Newton had indicated to a friend in late 1691 ought to be done: "a good design of a publick speech (and which may serve well at ane Act) may be to shew that the most simple laws of nature are observed in the structure of a great part of the Universe, that the philosophy ought there to begin. . . ."⁶⁵

From Boyle's endowed pulpit and in their writings the Newtonians preached to London-based and exceedingly prosperous congregations. They extolled the virtues of self-restraint and public-mindedness while at the same time assuring their congregations that prosperity came to the virtuous and that providence permitted, even fostered, material rewards. Men must acknowledge God's providence by the cultivation of virtue, by the pursuit of what Newton's tutor, Isaac Barrow, had called "sober self-interest," and by their support for Anglican hegemony. The same God whose laws of motion Newton had discerned in the natural world would also inevitably insure order, prosperity, and conquest and maintenance of empire in the political world. Adopting the language of the scientific novice, Newton's advocates used his science, as Restoration Anglicans had used theirs, to support the social ideology and political goals of the liberal Anglicanism which had been rendered supreme within the recently secured church.

With the lapsing of the Licensing Act in 1695 and with the heating up of party politics in the late 1690s, the liberal Anglican establishment, along with court and monarchy, found itself under assault by the radical and republican Whigs.⁶⁶ With the freethinker John Toland in the vanguard, they put forth materialistic and

⁶³*Ibid.*, pp. 12–13; cf. Millicent B. Rex, *University Representation in England, 1604–1690* (London: G. Allen & Unwin, 1954). For Newton's strong interest in his seat, see A. Rupert Hall and Laura Tilling, eds., *The Correspondence of Isaac Newton*, Vol. VII (Cambridge: Cambridge University Press, 1977), pp. 436–437.

⁶⁴Margaret Jacob, "Newtonianism and the Origins of the Enlightenment: A Reassessment," *Eighteenth Century Studies*, 1977, 11:1–25; on the circulation of Servetus manuscripts, see Lambeth Palace Library MS 933, fol. 74; cf. Jacob, *The Newtonians*, p. 221.

⁶⁵Memorandum made by David Gregory, Dec. 28, 1691, *Correspondence of Newton*, Vol. III, p. 191.

⁶⁶Jacob, *The Newtonians*, Ch. 6.

pantheistic—to use the word invented by Toland in 1705—arguments to justify the rule of Parliament over placemen and standing armies, of civic religion over established church, of religious pluralism over a narrowly circumscribed toleration. From their pulpits the Boyle lecturers, with Samuel Clarke as their most philosophically gifted spokesman,⁶⁷ put forth arguments to justify order and stability, to maintain the hierarchical and providential interpretation of the constitutional settlement.

But if Anglican hegemony now owed so much to Newtonian science, what did Newton's science owe to its religious and ideological roots? On the crucial level of matter theory, on Newton's insistence that universal gravitation must operate through immaterial forces in the universe and not as a property inherent in matter, it seems plausible to argue that Newton had accepted the central arguments of the Anglican virtuosi as formulated during the 1650s and beyond. Certainly his private manuscripts from as late as the 1690s repudiated the materialistic arguments by which "the vulgar" described the world and lashed out at those who postulated an impotent deity, a "dwarf-god," as Newton put it.⁶⁸ Newton's insistence on a mechanical philosophy that relied heavily on spiritual forces led him to adopt a baroque ontology which to this day has puzzled those purely philosophical commentators intent upon unraveling its complexity.⁶⁹ Our approach does not seek to minimize that complexity, but it does offer one explanation for its existence.

* * *

If we date the origins of the European Enlightenment to the 1690s in England, then it is now increasingly clear that English science from Boyle to Newton sponsored but one version of Enlightenment. Given what we now know about the institutional and ideological relations of the new science, in short about its Anglican origins, it must be acknowledged that, far from "preparing the ground for the deists of the Enlightenment" (as Westfall and others would have it),⁷⁰ the Newtonian Enlightenment was intended by its participants as a vast holding action against materialism and its concomitant republicanism, against what is best described as the Radical Enlightenment.

The implications of this distinction between the Newtonian and the Radical Enlightenments, based as it is on the content of belief as well as on the social relations of ideas, are significant for eighteenth-century European studies. For instance the characteristic materialism of the High Enlightenment, embodied in the writings of the

⁶⁷Samuel Clarke, *A Demonstration of the Being and Attributes of God: More Particularly in Answer to Mr. Hobbs, Spinoza, and their Followers* (London, 1705); cf. John Toland, *Socinianism truly Stated; Being An Example of fair Dealing in all Theological Controversys . . . by a Pantheist to an Orthodox Friend* (London, 1705); Giancarlo Carabelli, *Tolandiana* (Florence: La Nuova Italia, 1975), pp. 119–120.

⁶⁸J. E. McGuire, "Existence, Actuality and Necessity: Newton on Space and Time," *Annals of Science*, 1978, 35:470; on More and Newton as revealed in "De Gravitatione," pp. 471, 480–482; on Spinoza, p. 493; quotation from J. E. McGuire, "Newton on Place, Time and God: an Unpublished Source," *British Journal for the History of Science*, 1978, 11:114–123, from Cambridge University Library MSS Add. 3965, section 13, fols. 445r–446r.

⁶⁹For an excellent illustration of such complexity see J. E. McGuire, "Neoplatonism and Active Principles: Newton and the *Corpus Hermeticum*," in Robert S. Westman and J. E. McGuire, *Hermeticism and the Scientific Revolution* (Los Angeles: William Andrews Clark Memorial Library, University of California, 1977), pp. 120–125.

⁷⁰P. M. Heimann, "Science and the English Enlightenment," *History of Science*, 1978, 16:143–151; cf. R. S. Westfall, *Science and Religion in Seventeenth-Century England* (New Haven: Yale University Press, 1958), p. 219.

French philosophe Paul Henri d'Holbach, appears increasingly to have been alive and well decades before he wrote and to have flourished in republican circles on both sides of the Channel from at least as early as 1710. New evidence from Dutch archives reveals the elaborate social contacts of English republicans, Toland and Collins in particular, with French Protestant refugees who avidly read Spinoza while adopting Toland's own word, "pantheist," to describe themselves. This early coterie survived well into the 1750s, became deeply involved in Freemasonry in the Netherlands, and gave refuge to a variety of French materialists, among them the Abbé Yvon, who wrote so many of the essays on materialism for Diderot's *Encyclopédie* (1751).⁷¹

Jean Rousset de Missy (1686–1762), one of the founders of Dutch Freemasonry, knew Toland and Collins in The Hague in those early years (1710–1713), translated their works into French, and lived on to participate both in the Dutch Revolution of 1747 and in the first decade of the High Enlightenment, when materialism seemed everywhere triumphant.⁷² Now an old man, Rousset wrote to Prosper Marchand, who had been a good friend to Collins, to praise the *Encyclopédie*. The intellectual framework within which Rousset describes both Diderot's achievement and his concern that the remaining volumes will be suppressed by the censor establishes the continuity between the natural philosophy of the English radicals and the materialism of the Enlightenment:

Do you realize that if the theses [of the Abbé de Prades] had been permitted at the same time as the 10 enormous volumes of the *Encyclopédie*, it would have led rapidly to Pantheism; or it would have freed the wits, the wise and courageous women, also the Italian, English and French deists and atheists of the charade of Religion which is so necessary in society if we are not to be slaughtered [by one another], and useful for nothing else—and that is certainly enough; but [proudly?] I am "le petit Encyclopédiste."⁷³

Pantheism, derived specifically from the heresies of the English Revolution and transmitted by the English Commonwealthmen, lived on well into the Enlightenment and indeed permeated its clandestine literature.⁷⁴ Of course it merged with Spinozism as well as with varieties of Cartesian materialism, all indigenously continental versions of scientific naturalism.

Anglican science, conceptually and mathematically brilliant though it was, failed to accomplish one of its aims, to eradicate the radicalism of the English Revolution.

⁷¹John Lough, *The Contributors to the Encyclopédie* (London: Grant & Cutler, 1973), pp. 2–3; "Âme," in *Encyclopédie*, ed. Denis Diderot (Berne/Lausanne, 1781), Vol. II; "Immatérialisme," in *Encyclopédie*, Vol. XVIII. For Yvon's membership in an Amsterdam lodge, MSS 'Persoonsnamen Ordearchief,' compiled in 1756, the Grand Lodge of the Netherlands, The Hague. Our thanks to Mr. B. C. van Uchelen, librarian of The Grand Lodge.

⁷²Jean Sgard, "Jean Rousset de Missy," *Dictionnaire des journalistes* (Grenoble: Presses universitaires de Grenoble, 1976); cf. Margaret Jacob, "Newtonian Science and Radical Enlightenment," *Vistas in Astronomy*, 1979, 22:545–555. On Marchand and Collins, see James O'Higgins, S. J., *Anthony Collins* (The Hague: Martinus Nijhoff, 1970), p. 80; and various letters at the University of Leiden Library, Marchand MSS 2.

⁷³Rousset de Missy to Prosper Marchand, University of Leiden Library, Marchand MSS 2, fol. 47, 28/2, no year, but from the context probably 1752. De Prades's thesis was condemned in January, 1752. The original reads: "Savez vous que cela auroit été grand train vers le Panthéisme si ces Thèses eussent passé et en même tems les 10 énormes vol. de L'Encyclopédie, on débarassoit les beaux Esprits, les femmes savantes & galantes, les petits maîtres tant de déistes et d'athées Italiens & Anglois et françois du joug de la Religion si nécessaire dans la société pour n'y être pas égorgé, et pas pour autre chose, et c'en est bien assez, mais [altier?], je fais le petit Enciclopédiste."

⁷⁴Margaret Jacob, "The Radical Enlightenment: Pantheists, Freemasons and Republicans," forthcoming with Allen & Unwin, Ltd., 1980.

In the process, however, both its methodology and its metaphysics were shaped by the dialectics of revolution: as a result scientific arguments gave vital ideological support to Protestant monarchy. In this sense the triumph of Newtonian science represents another victory for the Whig constitution. The Anglican origins of modern science provide a new framework for integrating the history of science and English constitutional history—to the enrichment of both.