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"The true frame of Nature": Isaac Newton, Heresy, and the Reformation of Natural Philosophy

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> So then 'twas one designe of the first institution of the true religion to propose to mankind by the frame of the ancient Temples, the study of the frame of the world as the true Temple of the great God they worshipped. And thence it was that the Priests anciently were above other men well skilled in the knowledge of the true frame of Nature & accounted it a great part of their Theology.
>
> Isaac Newton[1]

Some of the ideas developed in this chapter formed part of my seminar at All Souls in February 2001. I am grateful to the seminar participants for their helpful comments. An earlier draft of this chapter was presented as a paper in May 2003 at the meeting of the Canadian Society for the History and Philosophy of Science in Halifax, Nova Scotia. I am likewise grateful to those attending this event for their useful feedback and advice. I would like to acknowledge the kind permission of the Syndics of the Cambridge University Library; the Jewish National and University Library, Jerusalem; and the Provost and Fellows of King's College, Cambridge. Except in a few select examples, transcriptions from Newton's manuscripts are presented in 'clean text' format, with abbreviations expanded, deletions omitted and insertion markers removed. Original capitalization and spelling have been retained. In addition to my own transcriptions, I utilized some of the growing collection of transcriptions being produced by the Newton Project (www.newtonproject.ic.ac.uk, accessed 13 April 2005).

[1] Isaac Newton, Jewish National and University Library, Jerusalem, Yahuda MS 41, fo. 7r.

NEWTON AND THE DUAL REFORMATION

In his notes for his projected biography of Isaac Newton, John Conduitt suggests that Newton had been engaged in the reform of both natural philosophy and theology—a dual reformation:

> The only thing he was heard to say with pleasure of his work: was when he died he should have the satisfaction of leaving Philosophy less mischievous than he found it—Those who will consider his Irenicum & Creed might allow him to have said the same of revealed religion—If there be any of so narrow principles as not to bear with his not going into one point of the highest orthodoxy let them reflect what an advantage it is to Christianity in general in this age of infidelity to have a Layman such a Philosopher &c. have spent so much study upon divinity & so publick & strenuous an advocate for it.[2]

The first claim, that Newton believed his labours would contribute to the improvement of natural philosophy, is presumably based on oral testimony to which Conduitt, who had married Newton's half-niece Catherine Barton in 1717, was privy. The second claim, that Newton may as well have said as much with respect to theology, appears to be based on an extrapolation from the contents of Newton's vast collection of religious papers, which fell into Conduitt's hands when the former died in 1727. But this is not all. As Conduitt hints in the second half of this passage, Newton's theological manuscripts reveal that the author of the *Principia* and the *Opticks* had veered into religious heterodoxy. Although this fact troubled the orthodox Anglican Conduitt, he was too familiar with Newton's private theological writings to deny it.

William Whiston, who was a convert both to Newton's natural philosophy and his unorthodox religion, had no such misgivings about the great man's denial of the Trinity. For him, it was reason for celebration. When writing about "the invention of the wonderful *Newtonian* philosophy", Whiston declares:

> I look upon [it] in an higher light than others, and as an eminent prelude and preparation to those happy *times of the restitution of all things, which*

[2] Conduitt, King's College, Cambridge, Keynes MS 130.7, fo. 2v.

God has spoken of by the mouth of all his holy prophets, since the world began, Acts iii. 21. To which purpose see his excellent corollaries relating to religion ... Nor can I forbear to wish, that my own most important discoveries concerning true religion, and primitive christianity, may succeed in the *second* place to his surprizing discoveries; and may together have such a divine blessing upon them, that the *kingdoms of this world*, as I firmly expect they will, may soon *become the kingdoms of our Lord, and of his Christ, and he may reign for ever and ever!* Amen. Amen.[3]

Whiston, too, thus argued for something like a dual reformation in natural philosophy and theology.[4] The premillenarianism that Whiston inherited in part from Newton also shines through his first claim. Newton's "surprizing discoveries" were to help prepare the way for the coming Millennium. And Whiston claims the same for his own discoveries concerning the primitive truth of Christianity. What he does not make explicit here is the fact that a great deal of his own heterodox theology owed much to Newton. Consciously or unconsciously, Whiston is thus arguing that this dual reformation is inherently a *Newtonian* dual reformation. The link between the renewal in natural philosophy and the recovery of the true religion is also hinted at in Whiston's reference to Newton's "excellent corollaries relating to religion"—an allusion to the natural theological and theological material Newton added to the conclusions of the later editions of his *Principia* and *Opticks*.

Few men knew Newton better than these two. As a relation, Conduitt was part of Newton's domestic circle. He also had unparalleled access to Newton's literary remains. As for Whiston, he enjoyed a twenty-year friendship with Newton that lasted until sometime around 1714. During these years he was given privileged access to Newton's thoughts on religion. Thus the statements of Conduitt and Whiston merit serious evaluation. I want to argue that they should not be taken as merely rhetorical, but that they instead reflect ideals and agendas to which Newton himself consciously adhered. This chapter has four main aims. First, by

[3] William Whiston, *Memoirs of the Life and Writings of Mr. William Whiston*, 2nd edn. (London, 1753), 34.

[4] In a work on natural theology, Whiston explicitly links advances in natural philosophy with progress in scriptural interpretation (William Whiston, *Astronomical Principles of Religion, Natural and Reveal'd* (London, 1717), 259, 272–7).

exploring Newton's belief that the ancient forms of both natural philosophy and religion had been corrupted and were therefore in need of purification, it will determine the degree to which Newton himself saw his work in terms of a 'dual reformation', that is to say, that he was consciously promoting two reformations. Second, it will show that these reformations in Newton's conception were fundamentally linked even if he wanted to preserve some distinctions between natural philosophy and religion. Third, this chapter will assess the relationship between Newton's published texts on natural philosophy and religion on the one hand, and draft material he composed on the *prisca sapientia* (ancient wisdom) and *prisca theologia* (ancient theology) on the other. Finally, it will be important to consider the role played by the pivotal dynamic of Newton's theological heresy and how this coloured his dual reformation as a whole.[5]

NEWTON'S DUAL REFORMATION IN HISTORY AND HISTORIOGRAPHY

A spirit of reform was in the air during the period in which Newton came of age. The early sixteenth-century Magisterial Reformation of Luther and Calvin unleashed a reformist impulse that in turn led to series of subsequent religious reform movements, including the Radical Reformation's Anabaptists and Socinians, who went much further than Luther and Calvin in seeking the renewal of Christianity. The central driving force behind all these movements was a primitivist impulse and the concomitant belief that the Medieval Church had

[5] I earlier explored the Newtonian religious reformation in Snobelen, 'Isaac Newton, Heretic: The Strategies of a Nicodemite', *The British Journal for the History of Science*, 32 (1999), 381–419 (where I suggest (p. 418) that Newton was participating in a dual reformation) and id., 'Caution, Conscience and the Newtonian Reformation: The Public and Private Heresies of Newton, Clarke and Whiston', *Enlightenment and Dissent*, 16 (1997), 151–84. I also treat aspects (mainly those not dealt with in this present chapter) of the relationship between Newton's heresy and his natural philosophy in Snobelen, 'To Discourse of God: Isaac Newton's Heterodox Theology and His Natural Philosophy', in Paul B. Wood (ed.), *Science and Dissent in England, 1688–1945* (Aldershot, Hants: Ashgate, 2004), 39–65.

become corrupt. This generally diffused primitivist impulse had been partly fed at the beginning of the Reformation by Renaissance humanism and philology. And it continued in Newton's own period. At the very moment when Newton came into the world in 1642 English Calvinists were clamouring for religious reform in England. As their name implies, one goal of the Puritans was to create a purer form of Christianity than that seen in High-Church Anglicanism, which was viewed as spiritually corrupt, excessively ritualistic, and over-institutionalized. This ideal is also seen in many of the dissenting movements of Newton's more mature years. But the Church of England itself also deployed the rhetoric of reform in its self-affirming characterizations of the Church of Rome as doctrinally, politically, and morally corrupt.

A reformation was also under way in natural philosophy. A century before Newton's birth Nicholas Copernicus and Andreas Vesalius, inspired in part by the same humanistic currents that helped motivate the religious reformers, helped initiate the period of the quickening of natural philosophical innovation and discovery that we now with hindsight refer to as the Scientific Revolution. This began shortly after the Protestant Reformation and was signalled by the 1543 publication of both Copernicus's *De revolutionibus* and Vesalius's *De fabrica*, works that transformed, respectively, astronomy and anatomy. The excitement generated by these works and those that followed from other innovating natural philosophers did not subside in the subsequent one hundred years. Yet neither Copernicus nor Vesalius championed a radical break with the past. Both were men of the Renaissance and both loosely subscribed to the Renaissance topos of the *prisca sapientia*, namely, that one of the highest goals of scholarship was to recover lost ancient wisdom. Copernicus saw his astronomical reformation as fulfilling the ideals of the ancient astronomers and modelled his *De revolutionibus* after Ptolemy's *Almagest*. Similarly, Vesalius was inspired by Galen when composing his *De fabrica*. Both men sought to perfect the work of their ancient exemplars. In other words, as we would say, they

[6] Peter Dear has recently spoken about a 'Scientific Renaissance' in the sixteenth century that focused on the reformation of knowledge and has distinguished this period from the 'Scientific Revolution' of the seventeenth century, that sought a more radical break with the past. For more on this, and how Copernicus and Vesalius exemplify this humanist tradition, see Dear, *Revolutionizing the Sciences: European Knowledge and Its Ambitions* (Houndmills: Palgrave, 2001), 8, 30–48.

thought in terms of reformation rather than revolution.[6] The irony in this is that although both men played down their break with the past, in important and far-reaching ways they did this very thing. Nearer to Newton's time in the seventeenth century, scholars began to think increasingly in terms of leaving the ancients behind. Thus, the French philosopher René Descartes self-consciously set out to reform, from the ground up, philosophy and natural philosophy, which he wanted to free from the stagnation and misdirection of Scholastic thought. Although in his rhetoric he claimed that he was making a decisive break with the past, there are many examples in Descartes's thought of continuity with the past. In a sense, Cartesianism amounted to a new Scholasticism. Still, Descartes's intellectual project served to stimulate a much more radical spirit of reform in natural philosophy.[7] Another relevant example from the seventeenth century is Francis Bacon, who appealed for the systematic reform of philosophy and natural philosophy in such works as the *Advancement of Learning* and the *Instauratio magna* (*The Great Instauration*). At the end of the seventeenth century and the beginning of the eighteenth century the legacies of the humanistic reform movements of the sixteenth century and the more recent radical reforming approaches clashed in the so-called 'Battle of the Books'.[8] Curiously, Newton exemplifies both traditions, although it is clear that his heart was with those who wanted to recover ancient knowledge.

Some early modern intellectuals saw links between the religious and natural philosophical reformations, a phenomenon treated in some recent historiography. John Hedley Brooke speaks about the seventeenth-century Protestant conception of two related reformations in his 1991 monograph on science and religion:

> For some Protestant thinkers, experimental science promised a way of reversing the effects of the original curse, a way of making a better world that might in some small way mirror the perfection of God's heavenly kingdom, a way of restoring the world to a condition fit for Christ's earthly rule. Affirmations of a strong parallel between religion and scientific reform are not difficult to find. Thomas Culpeper remarked in 1655 that, as Reformed theology rejected a pope in religion, so a reformed science rejected a pope in philosophy. It was easy to claim, as did Thomas Sprat in his

[7] Cf. Dear, *Revolutionizing the Sciences*, 48. [8] ibid.

History of the Royal Society (1667), that the two reformations had this in common: Each prized the original copies of God's two books, nature and the Bible, bypassing the corrupting influence of scholars and priests.[9]

As will be seen, these ideas resonate with those Newton himself held. In his 1998 work on Protestantism and early modern natural philosophy, Peter Harrison not only eloquently details the scholarly conception of two reformations, but provides a considerable number of examples of the relationship between the shift in biblical hermeneutics from the allegorical modes of the Medieval period to the literal-historical methods characteristic of Protestantism, and the movement away from the emblematic view of nature to a more empirical approach.[10] This particular link is germane to Newton's own thought. Another dynamic, that of millenarian aspirations, is evinced in the well-known frontispiece of Francis Bacon's *Instauratio magna*, which depicts ships of learning transgressing the limits of human knowledge represented by the Pillars of Hercules.[11] The epigram on this frontispiece, '*Multi pertransibunt et augebitur scientia*' ('Many shall run to and fro, and knowledge shall increase'), reflects Bacon's conviction that the quickening of knowledge we now call the Scientific Revolution was a fulfilment of biblical prophecy.[12]

Several studies in the past two decades have, in various ways, pointed to the dynamic of a dual reformation in Newton's thought. In his 1982 study of Newton's 'Origines', Richard Westfall argued that Newton, Whiston, and the English Cartesian Thomas Burnet all linked the restoration of true natural philosophy with the restoration of true natural religion.[13] John Gascoigne has also come to a similar conclusion about these three figures.[14] Newton's desire to use his

[9] John Hedley Brooke, *Science and Religion: Some Historical Perspectives* (Cambridge: Cambridge University Press, 1991), 111.

[10] Peter Harrison, *The Bible, Protestantism and the Rise of Natural Science* (Cambridge: Cambridge University Press, 1998), esp. 64–120.

[11] A reproduction of this image can be found in Steven Shapin, *The Scientific Revolution* (Chicago: Chicago University Press, 1996), 21.

[12] The epigram is a quotation of Daniel 12: 4.

[13] Richard Westfall, 'Isaac Newton's *Theologiae gentilis origines philosophicae*', in W. Warren Wagar (ed.), *The Secular Mind: Transformations of Faith in Modern Europe* (New York: Holmes & Meier, 1982), 26.

[14] John Gascoigne, ' "The Wisdom of the Egyptians" and the Secularization of History in the Age of Newton', in Stephen Gaukroger (ed.), *The Uses of Antiquity: The Scientific Revolution and the Classical Tradition* (Dordrecht: Kluwer, 1991), 188–9.

Principia to aid in the reinstatement of the *prisca theologia* is one of the themes of Simon Schaffer's 1987 essay on the providentialist aspects of Newton's cometography.[15] Similar themes are presented by Betty Jo Teeter Dobbs in her second monograph on Newton's alchemy, in which she set out the view that Newton believed the reformation of the true religion had been enhanced by the demonstrable successes of his *Principia*.[16] Kenneth Knoespel's 1999 essay on Newton's 'Origines' carefully considers the relationship between Newton's goals for the *Principia* and his efforts to recover the true religion, concluding that '[i]t is possible that Newton found in his own work the creation of a new interpretative instauration that would lay a foundation for a reformed religion integrating the moral teachings of Jesus with a knowledge of the coherence of creation', and that we gain much by drawing together 'Newton's interpretative work as a natural philosopher' and his 'interpretative work in history and religion'.[17] Building on the insights of these and other scholars, I will now turn to consider Newton's dual reformation in detail.

THE EARLY FOUNDATIONS OF NEWTON'S DUAL REFORMATION

Newton's religious awareness began before his interest in natural philosophy manifested itself, although both began early. He grew up in a Protestant world that saw the Bible as a chief focus; the Protestant faith and the Word of God were also central to his education at grammar school in the 1650s. It is also possible that early on he began to read through the two to three hundred

[15] Simon Schaffer, 'Newton's Comets and the Transformation of Astrology', in Patrick Curry (ed.), *Astrology, Science and Society* (Woodbridge: Boydell, 1987), 219–43.

[16] Betty Jo Dobbs, *The Janus Faces of Genius: The Role of Alchemy in Newton's Thought* (Cambridge: Cambridge University Press, 1991), 170.

[17] Kenneth Knoespel, 'Interpretative Strategies in Newton's *Theologicae gentilis origines philosophiae*', in James E. Force and Richard H. Popkin (eds.), *Newton and Religion: Context, Nature, and Influence* (Dordrecht: Kluwer, 1999), 179–202 (quotations from pp. 200 and 201).

theological books his stepfather the Reverend Barnabas Smith left behind at his death in 1653.[18] Four of ten books he is known to have bought in 1661, the year of his matriculation at Trinity College, Cambridge, were on theology.[19] A list of the sins of his youth that he compiled in 1662 attests to austere religious sensibilities.[20] But none of this is particularly exceptional for the time.

What was exceptional was his rapid move from the normal Scholastically based curriculum to an energetic and impassioned exploration of the new philosophy shortly after arriving at Cambridge. Partway through his four years of undergraduate studies, Newton left behind Aristotle and began a voyage of discovery into the new mechanical philosophy, imbibing the works of Descartes, Walter Charleton, Galileo, Robert Boyle, Thomas Hobbes, Henry More, and others.[21] Evidence of this extra-curricular reading and dramatic reorientation of his studies comes in part from a blank notebook he purchased the year he arrived at Trinity College. But already in his undergraduate days Newton also began to exhibit an interest in *ancient* alternatives to Aristotle, for Epicurean atomism and the Epicurean Lucretius also figure in these notes.[22] Moreover, these notes include matters theological. While it is true, as McGuire and Tamny point out, that Newton left a large gap between the headings relating to natural philosophy and the final two relating more overtly to theology ('Of the Creation' and 'Of the Soul'),[23] which may reflect some sort of intention to keep natural philosophy and theology separate in his notebook, it is nonetheless the case that theological topics occur in the natural philosophical section as well, including discussions of God, creation, the soul, and biblical exegesis.[24] This notebook suggests that Newton was already at this

[18] Richard Westfall, *Never at Rest: A Biography of Isaac Newton* (Cambridge: Cambridge University Press, 1980), 58.

[19] Ibid. 83, 309–10.

[20] Richard Westfall, 'Short-Writing and the State of Newton's Conscience, 1662', *Notes and Records of the Royal Society of London* 18 (1963), 10–16.

[21] Westfall, *Never at Rest*, 89.

[22] Newton in J. E. McGuire and Martin Tamny (eds.), *Certain Philosophical Questions: Newton's Trinity Notebook* (Cambridge: Cambridge University Press, 1983), 49–54, 119–20, 337–45, 421–5, 393.

[23] Ibid. 447–53. [24] Ibid. 337–9, 356–7, 374–5, 376–7, 406–9.

young age beginning to ponder how questions natural philosophical might relate to questions theological.

While Newton's 'Certain Philosophical Questions' reveals a period of natural philosophical discovery, other manuscripts demonstrate that the period from 1664 to 1666 also saw the blossoming of a brilliant mathematician, for it was during these years, the *anni mirabiles*, that Newton developed his method of fluxions (calculus), began his experiments on optics, and started work on his mathematical physics.[25] Towards the end of his *anni mirabiles*, probably by 1666, Newton added to his research programme the study of chemistry/alchemy (the distinction between the two being a more recent one). By the end of the decade, Newton had begun not only serious reading in alchemy, but had obtained two furnaces, initiated his own experimental programme, and also insinuated himself into secret alchemical networks.[26] Soon Newton would obtain from alchemy cognitive ingredients that would lead him away from mechanical philosophical orthodoxy. Newton's 'Certain Philosophical Questions' and his early exploration of alchemy provide ample evidence of an inquisitive and ranging mind, a mind that knew few intellectual boundaries. But they do not offer obvious signs of religious heresy.

These came in the early 1670s. Whether it was because his wide-ranging mind led him to move on to conquer theology, or whether it was because a 1675 ordination deadline spurred him on, Newton began a massive study of Church history and doctrine in the early 1670s, hot on the heels of his election to the Lucasian Professorship in 1669. This study became a consuming passion. As Westfall put it, 'there can be no reasonable question that at least part of the time, when Newton expressed impatience at the interruptions caused by optical and mathematical correspondence during the 1670s, it was theology that preoccupied him'.[27] Central to his new theological research project was a thorough examination (or re-examination) of the Word of God.[28] This intense study of the Scriptures quickly led him to conclude that the Trinity, the central tenet of Christianity

[25] An excellent account of Newton's *anni mirabiles* can be found in Westfall, *Never at Rest*, 140–75.

[26] Ibid. 96, 281–8.

[27] Ibid. 310. The other study was alchemy (ibid. 281).

[28] On this, see ibid. 310–25.

orthodoxy, was a post-biblical corruption. He was determined to bypass doctrinal innovation and recover the original faith of the first Christians. By the middle of the decade, he had arrived at a view of God akin to that of the ancient heresy of Arianism.

Central to his antitrinitarian, biblicist theology was the belief that only the Father is truly God. In the second in a list of twelve antitrinitarian statements he wrote out in the early 1670s, he asserted: 'The word God put absolutly without particular restriction to the Son or Holy ghost doth always signify the Father from one end of the scriptures to the other.'[29] The union between the Father and the Son is not one of substance, but a moral union of will.[30] In these early conclusions Newton believed he had recovered some of the original purity of primitive Christianity. From the perspective of his Trinitarian Anglican confrères, these conclusions constituted the deepest heresy. Newton could have publicized his new-found heresy, but this would have brought legal sanction and transformed him into a social pariah. Instead, he embraced a policy of secrecy much like that followed by the practice of alchemy with which he had become engaged less than a decade earlier. With some minor exceptions that will be examined below, Newton hid his heresy from the public and adopted the stance of a secret heretic—a Nicodemite.[31] But unpublished works like 'Paradoxical Questions concerning the morals and actions of Athanasius and his followers',[32] and his 'An historical account of two notable corruptions of Scripture in a Letter to a Friend',[33] both of which date from the years immediately after the publication of the *Principia*, reveal that Newton's theological agendas were both reformist and heretical. Although few knew in his lifetime, he shared similar radical aims to the late seventeenth and early eighteenth Unitarian opponents of the Church of England.

[29] Newton, Yahuda MS 14, fo. 25r. For a transcription of these twelve statements, see Westfall, *Never at Rest*, 315–16.

[30] Newton, Yahuda MS 14, fo. 25r.

[31] For more on Newton's Nicodemism, see Snobelen, 'Isaac Newton, Heretic'.

[32] William Andrews Clark Library (UCLA), MS **N563M3 P222. A shorter and later draft is Keynes MS 10; see also Keynes MS 11.

[33] Newton to John Locke, 14 November 1690, *The Correspondence of Isaac Newton*, ed. H. W. Turnbull, J. F. Scott, A. Rupert Hall, and Laura Tilling (7 vols.; Cambridge: Cambridge University Press, 1959–77), iii. 82. For the text of the 'Two Notable Corruptions', see ibid. iii. 83–144.

The most extensive manuscript Newton penned before writing the *Principia* was a 600-folio commentary on the Apocalypse. This early prophetic treatise, written when Newton was in his early thirties and still fresh with the exuberance of discovery, hints at associations between the study of God's Word and the study of God's Works. Because Newton believed that the same God who inspired the Scriptures also created the world, he was convinced that there were fundamental linkages between the Two Books:

> As the world, which to the naked eye exhibits the greatest variety of objects, appears very simple in its internall constitution when surveyed by a philosophic understanding, and so much the simpler by how much the better it is understood, so it is in these visions. It is the perfection of God's works that they are all done with the greatest simplicity. He is the God of order and not confusion. And therefore as they that would understand the frame of the world must indeavour to reduce their knowledg to all possible simplicity, so it must be in seeking to understand these visions.[34]

Not only should one expect a common simplicity in the Two Books, but, as each Book was written by the same Author, one should be able to use similar methods in the study of both.

THE *PRISCA SAPIENTIA* AND THE *PRINCIPIA MATHEMATICA*

Newton's burgeoning interest in early Christianity and biblical prophecy in the early to mid-1670s formed an important part of a broader research agenda with which he became passionately engaged in this period. It is around this time that Newton began an extensive survey of ancient writers in a quest to restore the ancient wisdom that had been lost through the corruption. This ancient wisdom had originally been given to Noah after the Flood and, crucially, embraced both religion and the philosophy of nature. His literal acceptance of the *prisca sapientia* tradition was both reformist and wide-ranging. As Niccolò Guicciardini notes, Newton's enthusiasm for the ancients extended to his alchemy, theology, and mathematics: 'It is striking that in the same years Newton began attributing to Jews,

[34] Newton, Yahuda MS 1.1a, fo. 14r.

Egyptians and Pythagoreans a lost knowledge concerning alchemy, God *and* mathematics. It is plausible that in Newton's mind the restoration of the lost books of the ancient geometers of Alexandria was linked to his attempt to re-establish a *prisca sapientia*'.[35] As Guicciardini demonstrates so well, Newton's classical turn in the 1670s and the emergence of his commitment to a *prisca geometria* provide illuminating backdrops for the writing of the *Principia* in the 1680s. In short, these dynamics reveal that he was trying to recover the methods of the ancients. This goes a long way to explaining the 'classical façade' of the *Principia*, which, as it happens, is not merely a façade.[36] Once again, this is not just rhetorical window-dressing; Newton's method is directly informed and shaped by the ancients.[37] Newton's commitment to the *prisca* tradition is one important context for the composition of the *Principia mathematica*. Another is his theological view of physics.

Sometime before the publication of the *Principia*, Newton wrote a treatise on natural philosophy in which he makes his break with Cartesianism explicit. This untitled treatise is now known by its initial words, 'De gravitatione et aequilibrium fluidorum' ('On the gravity and equilibrium of fluids'),[38] which some scholars now think dates to the years immediately prior to the composition of the *Principia*.[39] Perhaps more than any another other document that

[35] Niccolò Guicciardini, *Reading the* Principia: *The Debate on Newton's Mathematical Methods for Natural Philosophy from 1687 to 1736* (Cambridge: Cambridge University Press, 1999), 31.

[36] Yet the mathematics deployed in the *Principia* are not completely isomorphic with ancient geometry (see ibid. 99–117; I. Bernard Cohen, 'A Guide to Newton's *Principia*' in Newton, *The* Principia: *Mathematical Principles of Natural Philosophy*, trs. I. Bernard Cohen and Anne Whitman, assisted by Julia Budenz (Berkeley: University of California Press, 1999), 114–17, 122–7). As is often the case with his thought, Newton's *Principia* looks forward even as it looks to the past.

[37] For more on Newton's classicism, see Guicciardini, *Reading the* Principia, 27–38, 101–6. See also my review of Guicciardini, Snobelen, 'Mathematicians, Historians and Newton's *Principia*', *Annals of Science* 58 (2001), 75–84.

[38] A transcription and English translation can be found in A. Rupert Hall and Marie Boas Hall (eds.), *Unpublished Scientific Papers of Isaac Newton* (Cambridge: Cambridge University Press, 1962), 89–156.

[39] Dobbs, *The Janus Faces of Genius*, 138–44; J. E. McGuire, 'The Fate of the Date: The Theology of Newton's *Principia* Revisited', in Margaret J. Osler (ed.), *Rethinking the Scientific Revolution* (Cambridge: Cambridge University Press, 2000), 271–95. The Halls dated the manuscript to the period 1664–8 (Hall and Hall, *Unpublished Papers*, 89–90).

came from his hand, this manuscript demonstrates that Newton's natural philosophy was tightly bound up with a theistic understanding of the world. Not only is God a recurring and pivotal theme in 'De gravitatione', but Newton is at pains therein to develop an understanding of nature that is unambiguously and incontrovertibly dependent on God as a precondition. In this manuscript he also attacks the Cartesian natural philosophy as a system that encourages atheism. 'De gravitatione' forms an important theological backdrop to the first edition of the *Principia*, which, with its single reference to God and natural theology, appears misleadingly secular.[40]

The same is true of Newton's conception of the *prisca sapientia*, which is hinted at from the very first line of Newton's great work. The opening sentence of his preface to the first edition of the *Principia* reads:

> SINCE THE ANCIENTS (according to Pappus) considered mechanics to be of the greatest importance in the investigation of nature and science and since the moderns—rejecting substantial forms and occult qualities—have undertaken to reduce the phenomena of nature to mathematical laws, it has seemed best in this treatise to concentrate on *mathematics* as it relates to natural philosophy.[41]

On the surface of it, this programmatic statement appears to signal a bringing together of ancient mechanics and modern mathematics, and it is clear that the *Principia* at least does this. From the perspective of the history of science, Newton's *Mathematical Principles of Natural Philosophy* represents the culmination of the rise in status of mathematical realism in natural philosophy that is commonly traced out from Copernicus's *De revolutionibus* of 1543 through the works of such natural philosophers as Kepler, Galileo, and Descartes on to Newton. As with Kepler and some others, however, Newton's conviction that matter and geometry go hand in hand comes in good measure from his commitment to the number mysticism of the ancient pre-Socratic Pythagoreans. After his opening sentence,

[40] For more on the theological backdrop to the first edition of the *Principia*, see I. Bernard Cohen, 'Isaac Newton's *Principia*, the Scriptures, and the Divine Providence', in Sidney Morgenbesser, Patrick Suppes, and Morton White (eds.), *Philosophy, Science, and Method: Essays in Honor of Ernest Nagel* (New York: St Martin's, 1969), 523–48.

[41] Newton, *Principia* (Cohen-Whitman), 381.

Newton goes on in his preface to praise mathematics and in particular *geometry*, that powerful science of numbers that came to maturity three centuries before the time of Christ in the works of Euclid.

These are brief and obscure hints at Newton's commitments to the *prisca* tradition in the *Principia*. But he had considered publishing more explicit declarations. In the preface to book III of the *Principia*, Newton reveals that his original composition of book III was a less intensely mathematical affair than what he was publishing in 1687:

> On this subject I composed an earlier version of book 3 in popular form, so that it might be more widely read. But those who have not sufficiently grasped the principles set down here will certainly not perceive the force of the conclusions, nor will they lay aside the preconceptions to which they have become accustomed over many years; and therefore, to avoid lengthy disputations, I have translated the substance of the earlier version into propositions in a mathematical style, so that they may be read only by those who have first mastered the principles.[42]

From what we know of Newton, this explanation for the suppression of original *System of the world* (*De mundi systemate*) rings true.[43] But in addition to the general difference in style, the presence of nine hypotheses at the beginning (later converted into the four rules of reasoning and the six phenomena) and a more elaborate account of comets, the published version of book III differs from the original version in one more important respect: the *System of the World* is prefaced with an account of the views of the ancients on cosmology that reinforces Newton's commitment to the *prisca* tradition.[44]

This prefatory material opens with an explicit assertion that many of the earliest philosophers understood the universe to be heliocentric.[45] This heliocentric philosophy of nature, Newton elaborates, was taught 'of old' by Philolaus, Aristarchus of Samos, Plato 'in his riper years', the Pythagoreans, Anaximander ('more ancient still'), and

[42] Ibid. 795.

[43] An English translation of *De mundi systemate* can be found in Newton, *Sir Isaac Newton's Mathematical Principles of Natural Philosophy and His System of the World*, trs. Andrew Motte and rev. Florian Cajori (Berkeley, 1962; first pub. 1934), ii.

[44] For an English translation of a manuscript draft of this material (Cambridge University Library (hereinafter CUL) MS Add. 3990, fo. 1), see Westfall, *Never at Rest*, 434–5.

[45] Newton, *Principia* (Motte-Cajori), 549.

Numa Pompilius, the latter of whom Newton records as erecting a circular temple to honour Vesta with a 'perpetual fire' kept burning in its centre to present the sun.[46] Never mind that the Pythagorean system was not technically heliocentric in that it posited a central fire about which both the sun and earth revolved; it is enough that Newton believed it to be heliocentric. He is on firmer ground with Aristarchus of Samos, now sometimes referred to as the 'Copernicus of antiquity'. What is important here is that Newton is seeking an ancient, mainly pre-Socratic tradition of philosophy that upheld heliocentrism.

While acknowledging that some early philosophers such as Anaxagoras and Democritus believed 'that the earth possessed the centre of the world', Newton contends that the ancient heliocentrists and geocentrists alike held that 'the motions of the celestial bodies were performed in spaces altogether free and void of resistance'.[47] This, Newton implies, was the most ancient view. 'The whim of solid orbs', he continues, 'was of a later date, introduced by *Eudoxus, Calippus*, and *Aristotle*; when the ancient philosophy began to decline, and to give place to the new prevailing fictions of the *Greeks*'.[48] For Newton, early equals better. The doctrine of crystalline spheres (which held sway in some quarters into the early seventeenth century) is labelled a novelty and a fiction.

Newton next turns to comets, which he treats in both versions of book III, and points out that 'the phenomena of comets can by no means tolerate the idea of solid orbits'. The ancient Chaldeans, Newton adds, viewed comets as a species of planet that revolved around the sun. But with the introduction of solid orbits, comets were confined to the sublunary sphere and were only 'restored … to their ancient places in the higher heavens' by the observations of more recent astronomers.[49] With these observations, the crystalline spheres evaporated. It is important for Newton that this knowledge came through empirical rather than speculative means. It is also instructive that he uses the language of restoration.

[46] Newton, *Principia* (Motte-Cajori), 549. [47] Ibid. [48] Ibid. 549–50.
[49] Ibid. 550. Here Newton is thinking of developments in astronomy beginning with the late sixteenth century.

Newton suggests that the difficulty of explaining how a planet that otherwise would move away in a straight line from the body it is orbiting could be held within a circular orbit led the ancients to posit the notion of solid spheres. With the disappearance of these spheres, the moderns proposed other mechanical solutions, such as the vortical theories of Kepler and Descartes, or through the mechanism of 'impulse or attraction', as with Borelli and Hooke. Newton rejects these hypotheses and states instead that his method is the 'mathematical way' of describing the phenomena, a way that avoids 'all questions about the nature or quality of this force'.[50] Although he suppressed this prefatory material along with the entire treatise, Newton would return to these themes again and again in his private writings, the later drafts of the *Principia* and *Opticks* and even in the published versions of these texts.

THE CLASSICAL SCHOLIA

The introductory paragraphs of Newton's suppressed *System of the World* confirm that he saw his mathematical physics as a recovery of ancient lost knowledge in the terms of the *prisca sapientia*. By the early 1690s, when he was planning a second edition of the *Principia*, he was actively considering introducing bolder and more extensive affirmations of his commitment to the *prisca* tradition in additions to a revised version of his *magnum opus*. These intentions were relayed by Newton to David Gregory in his visit to Cambridge in May 1694.[51] Amongst notes taken after his meetings on 5, 6 and 7 May, Gregory records: 'He will spread himself in exhibiting the agreement of this philosophy with that of the Ancients and principally that of Thales. The philosophy of Epicurus and Lucretius is true and old, but was wrongly interpreted by the ancients as atheism'.[52] Written in Latin and Greek with copious references to ancient sources, the additions were meant to supplement propositions

[50] Ibid.

[51] For Gregory's memoranda on this visit, see *Correspondence of Newton*, iii. 334–55, 384–9.

[52] Gregory in *Correspondence of Newton*, iii. 335, 338.

IV–IX of book III and are now known collectively as 'the Classical Scholia'.[53]

In the six scholia Newton outlines several natural philosophical truths that he believed were anciently held by the ancient Egyptians, Greek pre-Socratics, and Epicureans. In the scholium meant to complement proposition IV, Newton writes:

> That the earth's moon is a ~~dense~~ body made of earth, and that it is heavy and would fall toward our earth due to the force of gravity if it were not prevented from doing so ~~and held in suspension on its path of rotation~~ due to the force of its circular motion, is an old view, since one school of philosophy taught namely that the earth's moon is an earth floating up above … This view appears to be taken from Ionic philosophy. This is what was passed on from Thales through Anaximander and Anaximenes to Anaxagoras.[54]

Later in this scholium, Newton not only contends that Anaxagoras believed that the moon was heavy, like the earth, but that '[t]hrough the fiction of the lion falling from the earth's moon and the stone falling from the sun he taught the gravity of the bodies of the sun and the earth's moon; through the figment of ascending stones he taught the force opposite to gravity, that of rotation.' To this he adds: 'This is not meant to be taken literally. The mystic philosophers usually hid their tenets behind such figments and mystical language.'[55]

[53] Newton's original autograph is Royal Society MS 247, fos. 6–14. The transcription in the hand of David Gregory is Royal Society MS 210. On the Classical Scholia, see J. E. McGuire and P. M. Rattansi, 'Newton and the "Pipes of Pan" ', *Notes and Record of the Royal Society*, 21 (1966), 108–42; Paolo Casini, 'Newton: the Classical Scholia', *History of Science*, 22 (1984), 1–58; Volkmar Schüller, *Newtons Scholia aus David Gregorys Nachlaβ zu den Propositionen IV–IX Buch III seiner* Principia (Berlin: Max-Planck-Institut für Wissenschaftsgeschichte, 2000); Schüller, 'Newton's *Scholia* from David Gregory's Estate on the Propositions IV through IX Book III of his *Principia*', in *Between Leibniz, Newton, and Kant: Philosophy and Science in the Eighteenth Century*, ed. Wolfgang Lefèvre (Dordrecht: Kluwer, 2001), 213–65; Alexandre Koyré and I. Bernard Cohen (eds.), *Isaac Newton, Isaac Newton's* Philosophiae Naturalis Principia Mathematica: *The Third Edition (1726) with Variant Readings* (Cambridge: Cambridge University Press, 1972), ii. 803–7. I use Schüller's translation below.

[54] Newton, 'Newton's *Scholia*', 219 (transcription style as in Schüller's original). Proposition IV reads: 'The moon gravitates toward the earth and by the force of gravity is always drawn back from rectilinear motion and kept in its orbit' (Newton, *Principia* (Cohen-Whitman), 803).

[55] Newton, 'Newton's *Scholia*', 221.

At the beginning of his scholium on proposition VI, Newton asserts: 'That all bodies located around the earth, air and fire as well as the others, are heavy toward the earth and that their gravity is proportional to the quantity of matter of which they consist, was known to the ancients,' and then goes on to quote from Lucretius's arguments for the existence of a void.[56] The first two sentences of the scholium on proposition VIII state:

> The ratio with which gravity decreases as the distance from the planet increases was not sufficiently explained by the ancients. They appear to have concealed this ratio using the harmony of the celestial spheres, whereby they portrayed the sun and the remaining six planets Mercury, Venus, Earth ~~Jupiter~~, Saturn as Apollo with the seven-stringed lyre and measured the intervals between the spheres through tone intervals.

And, after citing the testimony of Pliny, the Pythagoreans, Macrobius, Proclus, Aeschylus, and Eusebius, Newton concludes that '[t]hrough this symbol they indicated that the sun acts on the planets with its force in the same harmonic ratio to the different distances as that of the tensile force to strings of different length, i.e., in a duplicate inverse ratio to the distances.'[57] In other words, the ancients had understood the Inverse-Square Law of gravity, but as with the heaviness of the moon had concealed it in a figure.

In a variant draft of the scholium on proposition IX, Newton offers a hint about the cause of universal gravitation that adumbrates arguments that later found their way into the General Scholium of 1713. The opening lines of this variant draft read: 'Up to this point I have explained the properties of gravity. I have not made the slightest consideration about its cause. However, I would like to relate what the ancients thought about this ... Quite apparently the heavens are nearly free of bodies, but nevertheless filled everywhere with a certain infinite *spiritus*, which they called God.'[58]

[56] Ibid. 225. Proposition VI reads: 'All bodies gravitate toward each of the planets, and at any given distance from the center of any one planet the weight of any body whatever toward that planet is proportional to the quantity of matter which the body contains' (Newton, *Principia* (Cohen-Whitman), 806).

[57] Newton, 'Newton's *Scholia*', 235. Proposition VIII reads: 'Gravity exists in all bodies universally and is proportional to the quantity of matter in each' (Newton, *Principia* (Cohen-Whitman), 810).

[58] Newton, 'Newton's *Scholia*', 241. Proposition IX reads: 'In going inward from the surfaces of the planets, gravity decreases very nearly in the ratio of the distances from the planets' (Newton, *Principia* (Cohen-Whitman), 815).

Thus, even Newton's surmise that universal gravitation was in some way grounded in the omnipresence of God, something he spoke about openly in private and later hinted at in the General Scholium, is provided with an ancient antecedent. Near the end of the variant draft, Newton also claims that the ancient philosophers 'believed that this one God lives in all bodies as its temple, and thus they fashioned the old temples following the example of the heavens ~~the fire in the center of the temple for the sun~~ by portraying the sun as a fire in the center of the hall and the planets as the people walking around it, which they called the microcosm'.[59] It is likely that when Newton wrote '*unum Deum*' he was thinking of the one true God of the heretical antitrinitarian theology he had already espoused for two decades. Whether or not this is so, it is clear that he believed that the sages of deepest antiquity had a heliocentric conception of the solar system.

One can only speculate as to what the reaction would have been had the Classical Scholia been published in the second edition of the *Principia*, rather than having to wait until the mid-1960s to be revealed to the scholarly world. As it was, Newton did manage to insert some hints of his adherence to the *prisca* tradition in the General Scholium of the second edition when it was finally published in 1713. Published or not, Newton argues in the Classical Scholia that his mathematical physics represent a reformation of natural philosophy in that they are a revival of the lost *prisca sapientia*. And this does not need to be seen as mere rhetoric. After all, the mechanical philosophy of the seventeenth century itself emerged in part as a revival of ancient Epicureanism. It is possible that Newton actually obtained insights from his study of ancient natural philosophy.

THE DUAL REFORMATION IN THE 'ORIGINES'

The *Principia* was not the only treatise Newton laboured on in the mid- to late 1680s. During the same years that saw the composition of the *Philosophiae naturalis principia mathematica*, Newton

[59] Newton, 'Newton's *Scholia*', 243.

produced a monumental manuscript bearing the title 'Theologiae gentilis origines philosophicae' ('The Philosophical Origins of Gentile Theology').[60] During Gregory's visit to Newton at Cambridge in May 1694, shortly after this manuscript was completed, Newton either summarized its contents or allowed Gregory to peruse the document. It is difficult to improve on Gregory's pithy synopsis:

> He has written a tract on the origin of the Gentiles [*gens*]. Religion is the same at all times, but that which was received pure by Noah and the first men, the Nations [*Ethnicus*] corrupted by their own inventions; Moses initiated a reformation [*reformatio*] but retained the indifferent things [*adiaphora*] of the Egyptians (it was the Egyptians who most of all corrupted religion with superstition and from them it spread to other Gentiles [*gens*]). Christ reformed [*reformō*] the religion of Moses.[61]

As Gregory's notes insinuate, the themes of corruption and reformation are central to the 'Origines'. A disordered and inchoate document, scholarship on the 'Origines' is still in its early stages.[62] Westfall, one of the first to study the 'Origines', recognized that one of its central messages was that 'true natural philosophy supports true religion'.[63]

In the 'Origines' Newton's primitivism became more ambitious as his study of religious corruption expanded to include a recovery of the Ur-religion of the Noachides. This was the ultimate goal, because this religion was the post-Diluvial restoration of the original religion

[60] Newton, Yahuda MSS 16.1 and 16.2; related material can be found in Newton, Yahuda MSS 17.1, 17.2, and 17.3. A later (*c.* early 1690s), shorter draft in English can be found in Yahuda MS 41. Sections of Yahuda MS 16 are written in the hand of Humphrey Newton, who was Isaac Newton's amanuensis from *c.*1685 to 1690. Humphrey Newton also copied out *De motu*, Newton's Lucasian Lectures for 1685 and 1686, *De mundi systemate*, and the fair copy of the first edition of the *Principia* (I. Bernard Cohen, *Introduction to Newton's 'Principia'* (Cambridge: Cambridge University Press, 1971), 299).

[61] Gregory in *Correspondence of Newton*, iii. 336, 338. I have adapted the translation given in the *Correspondence*.

[62] On the 'Origines', see Westfall, 'Newton's *Theologiae Gentilis Origines Philosophicae*', 15–34; id. *Never at Rest*, 351–6. Westfall's thesis in his article that Newton was a proto-deist is untenable on several grounds, including the fact that he was a biblicist and a believer in scriptural prophecy. See the corrective provided in James E. Force, 'Newton and Deism', *Science and Religion/Wissenschaft und Religion*, ed. Änne Bäumer and Manfred Büttner (Bochum: Brockmeyer, 1989), 120–32.

[63] Westfall, *Never at Rest*, 407.

of humanity, as practised by Cain and Abel. This faith was simple, ethical, and monotheistic. It also involved the study of God's creation. Newton initiated this massive study of religious ethnography, ancient mythology, pagan idolatry, and Gentile theology not only to identify the features of the first religion and trace its subsequent corruption, but also to distill the original, true understanding of nature. It is instructive that this project began not in Newton's declining years, but around the same time he composed and published the first edition of the *Principia*—a book that he believed revealed the true understanding of nature that had been lost centuries before. Newton begins a draft of chapter one by arguing that 'the Gentile theology was philosophical and above all looked to the astronomical and physical knowledge of the system of the world'.[64] Adding to this, he asserts that the ancients 'practised a two-fold philosophy, sacred and vulgar: the Philosophers handed down the sacred to their disciples through types and riddles, while the Orators recorded the vulgar openly and in a popular style'.[65] Newton goes on to say that this original 'sacred philosophy flourished above all in Egypt and was founded on the knowledge of the stars'.[66] As Westfall points out, Newton often referred to this original philosophy as 'astronomical theology'.[67]

The slightly later and more orderly English draft of this material helps reveal the main contours of Newton's arguments. He begins this draft: 'The religion most ancient and most generally received by the nations in the first ages was that of the Prytanea or Vestal Temples'.[68] These Temples were built around a central fire, which Newton believed was meant to represent the sun in the heliocentric view of the solar system. Later in this manuscript he states:

[64] Newton, Yahuda MS 16.2, fo. 1r (my translation). The original Latin is: '*Quod Theologia Gentilis Philosophica erat, et ad scientiam Astronomicam & Physicam systematis mundani apprimè spectabat*'.

[65] Newton, Yahuda MS 16.2, fo. 1r (my translation). The original Latin is: 'Philosophiam antiquam duplicem coluere, sacram et vulgarem, sacram Philosophi per typos et ænigmata discipulis suis tradidere: vulgarem Oratores aperte et stylo populari scripserunt'. Newton's use of the verb *colō* is noteworthy, as this word, from which *cultus* is derived, not only can have the senses 'practise', 'cultivate', or 'study', but can also refer to religious worship.

[66] Newton, Yahuda MS 16.2, fo. 1r (my translation). The original Latin is: 'Philosophia sacra in Ægypto apprimè floruit et in scientia syderum fundata fuit'.

[67] Westfall, *Never at Rest*, 353.

[68] Newton, Yahuda MS 41, fo. 1r.

as the Tabernacle was contrived by Moses to be a symbol of the heavens (as St. Paul & Josephus teach) so were the Prytanæa amongst the nations ... The whole heavens they recconed to be the true & real Temple of God & therefore that a Prytanæum might deserve the name of his Temple they framed it so as in the fittest manner to represent the whole systeme of the heavens. A point of religion then which nothing can be more rational.[69]

The Jewish Tabernacle and Temple were pure representations of the system of the heavens. Other ancient nations corrupted their Temples and worship with idolatry and polytheism.

Shortly afterward, Newton extends his discussion about the purpose of ancient temples to elaborate the role of the ancient priests:

So then 'twas one designe of the ~~true systeme of the~~ first institution of the true religion to propose to mankind by the frame of the ancient Temples, the study of the frame of the world as the true Temple of the great God they worshipped. And thence it was that the Priests anciently were above other men well skilled in the knowledge of the true frame of Nature & accounted it a great part of their Theology ... The learning of the Indians lay in the Brachmans who were their Priests, that of the Persians in the Magi who were their Priests, that of the Babylonians in the Chaldeans who were their Priests ... So then the first religion was the most rational of all others till the nations corrupted it. For there is no way <(without revelation)> to come to the knowledge of a Deity but by the frame of nature.[70]

Newton thus believed the ancients saw a link between earthly temples and the heavenly temple and thus between theology and cosmology. The ideal of a physico-theology, which involved an empirical study of nature and was championed by many natural philosophers in the late seventeenth and early eighteenth centuries, Newton saw prefigured in the ancient prytanaeum. And, because one could discover knowledge about God in nature (as one could also discover knowledge about God in the Scriptures), a pure and correct method for the study of nature was required. Newton's use of the expression 'system of the world' in his *Principia* takes on added meaning against the backdrop of the synonymous expressions 'system of the heavens', 'frame of the world', 'true frame of nature', and 'frame of nature' used in this private manuscript. What is more, the claim that natural philosophy

[69] Ibid. fos. 5r–6r.
[70] Ibid. fo. 7r. One deletion and one set of insertion markers retained.

was a *part* of the original religion's theology, and thus perhaps subordinate to it, is reminiscent of the Medieval commonplace that natural philosophy was a handmaid (*ancilla*) to theology, the queen of the sciences. Whatever Newton is saying about the relationship of natural philosophy to theology, it is clear that he believed the roles of theologian and natural philosopher converged in the role of the priests in the original religion.

There is evidence to suggest a reflexive dynamic in these commitments. In 1692 the young Cambridge clergyman Richard Bentley preached the first Boyle Lectures in defence of Christianity. When revising these lectures for publication, Bentley sought Newton's help in bolstering the apologetics of the seventh and eighth sermons with the physics of the *Principia*.[71] In all, Newton wrote four letters in reply to Bentley.[72] The opening sentence of his first epistolary reply is now famous: 'When I wrote my treatise about our Systeme I had an eye upon such Principles as might work wth considering men for the beleife of a Deity & nothing can rejoyce me more then to find it usefull for that purpose'.[73] Newton went on in this first letter and the three that followed to sketch out a series of arguments from his physics and astronomy for design in nature. Newton's letters to Bentley are too well known to require further comment. But Newton's testimony, even though it is found in a letter to a clergyman, provides additional evidence that the author of the *Principia* also had theological aims in mind for his great work.

Another example is a manuscript on place, time, and God that dates from the early 1690s.[74] Written in Latin and bereft of a title (I

[71] The first six lectures were issued as separate volumes in 1692; the final two were issued in 1693, both bearing the title *A Confutation of Atheism from the Origin and Frame of the World*. These two volumes are reproduced in facsimile in I. Bernard Cohen and Robert E. Schofield (eds.), *Isaac Newton's Papers and Letters on Natural Philosophy* (Cambridge: Cambridge University Press, 1958), 313–94.

[72] Newton to Bentley, 10 December 1692, 17 January 1693, 11 February 1693, 25 February 1693, *Correspondence of Newton*, iii. 233–6, 238–40, 244–5, 253–6; the 1756 printed edition of these letters appears in Cohen and Schofield (eds.), *Newton's Papers and Letters on Natural Philosophy*, 279–312.

[73] Newton to Bentley, 10 December 1692, *Correspondence of Newton*, iii. 233.

[74] CUL MS Add. 3965, section 13, fos. 541r–542r, 545r–546r; J. E. McGuire, 'Newton on Place, Time, and God: An Unpublished Source', *British Journal for the History of Science* 11/38 (1978), 114–29; a transcription of the original Latin and an English translation can be found on pp. 116–23.

will refer to it by its first three words, 'Tempus et locus'), this manuscript consists of eight numbered paragraphs. Not only is 'Tempus et locus' based in part on 'De gravitatione', but it overlaps in content with the Scholium on the Definitions,[75] thus further revealing and establishing the theological context of Newton's conception of space and time in the *Principia*. In paragraph four, after mentioning the eternity and infinity of space, Newton articulates the argument from plenitude, asserting that 'God ... will be demonstrated to be more powerful, wiser, better, and in every way more perfect from the eternal succession and infinite number of his works, than He would be from works merely finite.' At some point after penning this paragraph, he added the statement: 'Nam Deus ex operibus cognoscitur' ('For God is known from his works').[76] In this terse five-word sentence, Newton sums up his entire empirical natural theology.

THE DUAL REFORMATION IN THE *OPTICKS*

In his memoranda on his visit to Cambridge in May 1694—the visit during which Newton discussed his 'Origines' and revealed to him the 'Classical Scholia'—David Gregory also reported seeing 'Three Books of Opticks'.[77] Whatever the reason for the delay (some speculate that Newton was waiting for the death of his critic Robert Hooke), it would be another decade before the *Opticks* appeared. Like the first edition of the *Principia*, the first edition of the *Opticks* contained few hints that Newton was engaged in a dual reformation. But also as with the *Principia*, Newton both contemplated including bold statements in the first edition of the *Opticks* and added such in later editions.

Included in a series of manuscripts that relate to Newton's final revisions and additions to the first edition of the *Opticks*, including the original sixteen Queries, is a draft preface and an associated

[75] McGuire, 'Newton on Place, Time, and God', 124.
[76] Newton, Ibid. 119.
[77] Gregory in *Correspondence of Newton*, iii. 338.

fragment that treat, among other things, Newton's natural philosophical method and natural theology. They can confidently be dated to the three or four years immediately prior to the 1704 publication of the *Opticks*. J. E. McGuire gave the title 'Principles of Philosophy' to the first document and published transcriptions of both in 1970.[78] In this document Newton seeks to outline his empirical natural philosophical method and he does this by listing four examples of the method. The first comes straight from natural theology: 'One principle in Philosophy is y^{e} being of a God or Spirit infinite eternal omniscient omnipotent, & the best argument for such a being is the frame of nature & chiefly the contrivance of y^{e} bodies of living creatures.' Once again we see Newton using the crucial expression 'the frame of nature'—an expression found in his 'Original of Religions'. It is also instructive that Newton states that the being of God is a principle in natural philosophy. One can find evidence of God's creative hand at work in the frame or structure of nature and Newton goes on to expostulate about the symmetry in the structure of the bodies of animals: 'All the great land animals have two eyes in the forehead, a nose between them a mouth under the nose, two ears on y^{e} sides of y^{e} head, two arms or two fore leggs or two wings on the sholders & two leggs behind & this symmetry in y^{e} several species could not proceed from chance there being an equall chance for one eye or for three or four eyes as for two, & so of the other members'.[79] After elaborating on this argument, Newton concludes:

> & therefore y^{e} first formation of every species of creatures must be ascribed to an intelligent being (such a being as we call God). These & such like considerations are the most convincing arguments for such a being & have convinced mankind in all ages that y^{e} world & all the species of things therein were originally framed by his power & wisdom. And to lay aside this argum^{t} is (very) unphilosophical.[80]

[78] J. E. McGuire, ' "Newton's Principles of Philosophy": An Intended Preface for the 1704 *Opticks* and a Related Draft Fragment', *The British Journal for the History of Science*, 5 (1970), 178–86. The manuscript reference is CUL MS Add. 3970.3. fo. 479r–v and 480v. As they are difficult to distinguish, I have omitted McGuire's transcriptions of Newton's deletions and insertions.

[79] Newton in McGuire, 'Newton's "Principles of Philosophy" ', 183.

[80] Newton, ibid. The material in parentheses is in McGuire's transcription and probably consists of Newton's insertions.

Thus, Newton argues, an empirical examination of the 'frame of nature' will lead one directly to God.[81]

Although they did not form part of the first edition of 1704, some of the natural theological arguments of the 'Principles of Philosophy' made an appearance in modified and attenuated forms at the end of Queries 28 and 31 in the later editions of the *Opticks*.[82] This happened first when Newton added these and other Queries to the first Latin edition of 1706.[83] They first appeared in English in the second English edition of 1717, and then in the English editions of 1721 and 1730.[84] Query 28 opens with an attack on Descartes's impulse theory of light and concludes with an inductive argument from design. At the end of the penultimate paragraph of this Query, Newton rejects the aetherial medium required for the Cartesian theory of light and then commences the final paragraph as follows: 'And for rejecting such a Medium, we have the Authority of those the oldest and most celebrated Philosophers of *Greece* and *Phœnicia*, who made a *Vacuum*, and Atoms, and the Gravity of Atoms, the first Principles of their Philosophy; tacitly attributing Gravity to some other cause than dense Matter.'[85] In these words, which first appeared in the Latin edition of 1706, we see a hint at the arguments about the ancients he presented in much more detail in the suppressed Classical Scholia finally making it into a public text.

[81] Another example of Newton's use of the expression 'frame of the world' (a term Bentley used in the title of his Boyle Lectures) as part of a natural theological argument can be found in Sotheby's 1936 Lot 255.1 (Sotheby's 2004 Lot 511.i; private collection), where Newton wrote: 'The wisdom and power which appears in the frame of the world and its various parts is sufficient to convince men that they were framed by a wise and powerful being' (transcription courtesy of Jean-François Baillon).

[82] McGuire recognized this in a note to his 1970 transcription (McGuire, 'Newton's "Principles of Philosophy" ', 183 n. 19).

[83] Newton, *Optice: sive de reflexionibus, refractionibus, inflexionibus & coloribus lucis libri tres* (London, 1706), 314–15, 345–6. Newton added Queries numbered 17–23 to the 1706 edition. The Latin edition was translated by Newton's associate Samuel Clarke.

[84] For their form in the final, fourth edn., see Newton, *Opticks*, 369–70, 402–3. Newton inserted eight new Queries in the English edition of 1717 immediately after the original sixteen (as Queries 17–24), and renumbered the seven Queries added to the Latin edition 1706 as 25–31. Thus, Queries 28 and 31 in the later English editions correspond to Queries 20 and 23 in the 1706 edition (see A. Rupert Hall, *All Was Light: An Introduction to Newton's* Opticks (Oxford: Clarendon, 1993), 238).

[85] Newton, *Opticks*, 369.

But there is more. He continues his argument by attacking the hypothetical-deductive method:

> Later Philosophers banish the Consideration of such a Cause out of natural Philosophy, feigning Hypotheses for explaining all things mechanically, and referring other Causes to Metaphysicks: Whereas the main Business of natural Philosophy is to argue from Phænomena without feigning Hypotheses, and to deduce Causes from Effects, till we come to the very first Cause, which certainly is not mechanical; and not only to unfold the Mechanism of the World, but chiefly to resolve these and such like Questions.[86]

Not only is this a stinging critique of the excesses of the mechanical philosophy, but it also contends that an inductive study of nature will lead to the conclusion that nature is ultimately contingent on the Creator. Additionally, it is this inductive method—not the failed method of Descartes—that will reveal the 'Mechanism of the World'. Newton bolsters these arguments with a list of natural phenomena that he believes attest to the existence of a divine designer, including the motions of comets and planets, the placement of the stars and the bodies of animals. He concludes this Query with another apologetic statement: 'And though every true Step made in this Philosophy brings us not immediately to the Knowledge of the first Cause, yet it brings us nearer to it, and on that account is to be highly valued.'[87] It is precisely because it leads to a knowledge of God that Newton believes his method is superior.

The sanitized statements on natural theology found in the published editions of the *Opticks* amount to what he allowed to slip through his own self-censorship. But as is often the case with his public documents, these cautious statements can be illuminated by the frank language of his unpublished manuscripts. The best example of this is an English draft of Query 23 (31) that dates to around the time of the publication of the Latin edition of 1706.[88] This draft opens with a more explicit articulation of the argument about the

[86] Newton, *Optics*, 369. [87] Ibid. 370.

[88] Westfall suggests that this draft dates to around 1705 (*Never at Rest*, 647). Given the use of the number '23' for the Query, it certainly cannot date more than a year earlier than this. The same consideration shows that it must date to before 1717, when the second English edition was published complete with its renumbered Queries.

ancients and the vacuum that appeared near the end of Query 28 (20):

> Qu 23. By what means do bodies act on one another at a distance. The ancient Philosophers who held Atoms & Vacuum attributed gravity to Atoms without telling us the means unless perhaps in figures: as by calling God Harmony & representing him & matter by the God Pan & his Pipe, or by calling the Sun the prison of Jupiter because he keeps the Planets in their orbs. Whence it seems to have been an ancient opinion that matter depends upon a Deity for its laws of motion as well as for its existence.[89]

Thus Newton not only considered opening a window on the contents of the Classical Scholia, but also considered running an argument that supported his belief that the laws of motion were contingent on the existence of God and that this belief had an ancient precedent. Two paragraphs later he launches into an attack on the hypothetical method:

> A man may argue plausibly for blind fate against final causes but I find by experience that … I am constantly aiming at something. Were it not for experience I should not know that matter is heavy or impenetrable or moveable or that I think or am or that there is matter or any thing else. And therefore to affirm any thing more then I know by experience & reasoning upon it is precarious. Even arguments for a Deity if not taken from Phænomena are slippery & serve only for ostentation.[90]

In these lines Newton makes it clear that one of the chief defects of the hypothetical method of Descartes is that it does not offer secure arguments for the existence of God. At this point he raises the spectre of atheism, suggesting that 'An Atheist will allow that there is a Being absolutely perfect, necessarily existing & the author of mankind & call it Nature'.[91] Morever, Newton adds that the atheist 'may tell you further that the Author of mankind was destitute of wisdome & designe because there are no final causes & and that matter is space & therefore necessarily existing & having always the same quantity of motion, would in infinite time run through all variety of forms one of which is that of man'.[92]

[89] CUL MS Add. 3970 (B), fo. 619r.

[90] Ibid. A pointed dig at Descartes's *cogito* and rationalist methodology can be detected in the fifth line of this excerpt.

[91] Ibid.

[92] Ibid. fos. 619r–v.

For Newton, it is God who is necessarily existing in that nature is dependent on his existence:

> We see the effects of a Deity in the creation & thence gather the cause & therefore the proof of a Deity & what are his properties belongs to experimental Philosophy. 'Tis the business of this Philosophy to argue from the effects to their causes till we come at the first cause & not to argue from any cause to the effect till the cause as to its being & quality is sufficiently discovered.[93]

Thus, although Newton uses the more polite term 'unphilosophical' in his draft 'Principles of Philosophy' and in the published Query 31, his private papers show that what he really meant is that such arguments incline to atheism.[94] In contrast, he believed that his method leads straight in the opposite direction. What these arguments show is that Newton believed the same inductive method that yielded such spectacular results in natural philosophy would also lead to the pious conclusion that there was and is a creative hand at work behind the 'frame of nature'.

THE DUAL REFORMATION IN THE GENERAL SCHOLIUM

When Newton published the second edition of his *Principia* in 1713 he added a concluding General Scholium.[95] In this short document he made explicit some of his views about the *prisca sapientia* and *prisca theologia* to which he had subscribed at the time of the

[93] A pointed dig at Descartes's *cogito* and rationalist methodology can be detected in the fifth line of this excerpt. fo. 619r.

[94] Cf. Newton, Keynes MS 7, fo. 1, where he also openly attacks atheism at the beginning of another articulation of the argument from design based on the symmetry of structure in animal bodies.

[95] On the General Scholium, see James E. Force, 'Newton's God of Dominion' 'Newton's God of Dominion: The Unity of Newton's Theological, Scientific and Political Thought', in J. E. Force and Richard H. Popkin, *Essays on the Context, Nature and Influence of Isaac Newton's Theology* (Dordrecht: Kluwer, 1990), 75–102; R. De Smet and K. Verelst, 'Newton's Scholium Generale: The Platonic and Stoic Legacy—Philo, Justus Lipsius and the Cambridge Platonists', *History of Science*, 39 (2001), 1–30; Stephen Snobelen, ' "God of Gods, and Lord of Lords": The Theology of Isaac Newton's General Scholium to the *Principia*', *Osiris*, 16 (2001), 169–208; Larry Stewart, 'Seeing Through the Scholium: Religion and Reading Newton in the Eighteenth Century', *History of Science*, 34 (1996), 123–65.

publication of the first edition of the *Principia*, but had cautiously withheld from public scrutiny. This document is laced with explicit and not-so-explicit clues to Newton's natural philosophical and theological agendas. The natural philosophical apologetics of the General Scholium are made evident from its very first line: 'The hypothesis of vortices is beset with many difficulties.'[96] In the paragraph headed by this declaration Newton rids the universe of vortices using the empirical evidence that came from the eccentric motion of comets.[97] Without lingering on this point, Newton moves quickly to eliminate the subtle aether on which the Cartesian vortical system depended. The celestial spaces are like the vacuum in Boyle's air-pump: 'All bodies must move very freely in these spaces, and therefore planets and comets must revolve continually in orbits given in kind and in position, according to the laws set forth above' (i.e. in the *Principia*).[98]

Newton next describes how the six primary planets revolve in the same direction on a near plane and concludes: 'And all these regular motions do not have their origin in mechanical causes, since comets go freely in very eccentric orbits and into all parts of the heavens.'[99] The cause, which is certainly not mechanical, is God himself: 'This most elegant system of the sun, planets, and comets could not have arisen without the design and dominion of an intelligent and powerful being.'[100] Not only is this beautiful system contingent on the dominion of God, but the unity of natural phenomena is grounded in, and guaranteed by, his unity: 'And if the fixed stars are the centers of similar systems, they will all be constructed according to a similar design and subject to the dominion of *One*, especially since the light of the fixed stars is of the same nature as the light of the sun, and all the systems send light into all the others'.[101]

Having introduced his God, Newton goes on to describe him: 'He rules all things, not as the world soul but as the lord of all. And because of his dominion he is called Lord God *Pantokrator*.'[102] This use of a biblical name of God initiates a string of biblical titles and attributes for God, including 'my God', 'your God', 'the God of Israel', 'God of Gods', and 'Lord of Lords'.[103] All these titles are

[96] Newton, *Principia* (Cohen-Whitman), 939.
[97] Ibid. [98] Ibid. 940. [99] Ibid. [100] Ibid.
[101] Ibid. [102] Ibid. [103] Ibid. 940–1.

meant to emphasize that the true God is not an abstract perfection remote from the physical world. Instead, he is a God of dominion, the meaning of whose names and the reality of whose sovereignty derive from his standing in relation to all that is contingent on him, whether his creation or his creatures. This God of dominion is the God of Newton's faith *and* his natural philosophy. This is also the God of Newton's absolute space and time:

> He is eternal and infinite, omnipotent and omniscient, that is, he endures from eternity to eternity, and he is present from infinity to infinity; he rules all things, and he knows all things that happen or can happen. He is not eternity and infinity, but eternal and infinite; he is not duration and space, but he endures always and is present everywhere, and by existing always and everywhere he constitutes duration and space.[104]

God comes first, and hence absolute space and time are predicates of God's infinite extension and eternal duration.

What may appear at first glance to be only a partially relevant excursus on the nature of God is in fact much more than this: it is an argument that also hints at an alternative for the mechanical aether of Descartes that he has summarily dismissed in the introduction of the General Scholium. This alternative is the omnipresence of God. Having determined that gravity is universal, Newton hints that an explanation for the universality and immediacy of gravity can be found in the infinite extension of God's presence through his Spirit: 'In him all things are contained and move, but he does not act on them nor they on him. God experiences nothing from the motions of bodies; the bodies feel no resistance from God's omnipresence.'[105] The line 'in him all things are contained and move' is taken from Acts 17: 28, which records its use by the Apostle Paul. Paul, in turn, as Newton knew, was citing the Stoic writer Aratus's *Phaenomena*. This is stressed in a footnote on this statement, which begins: 'This opinion was held by the ancients.' Newton then lists Pythagoras, Cicero, Thales, Virgil, Philo Judaeus, and Aratus as ancient authors who also espoused this view. He adds to these names Paul, John, Moses, David, Solomon, and Jeremiah as biblical authors who likewise believed in God's omnipresence and that creation is contained

[104] Newton, *Principia* (Cohen-Whitman), 941. [105] Ibid. 941–2.

within this divine omnipresence.[106] Thus, although he aborted his plans to include the Classical Scholia in the second edition of the *Principia*, an element of the argument contained therein appears in the footnote on God and space.

Newton is also at pains to emphasize that these truths about the Deity do not derive from direct experience, inner light, Platonic forms, or Cartesian distinct ideas: 'But there is no direct sense and there are no indirect reflected actions by which we know innermost substances; much less do we have an idea of the substance of God. We know him only by his properties and attributes and by the wisest and best construction of things and their final causes, and we admire him because of his perfections; but we venerate and worship him because of his dominion.'[107] Once again, Newton articulates his belief in a nature that is utterly contingent on the existence of God: 'All the diversity of created things, each in its place and time, could only have arisen from the ideas and the will of a necessarily existing being'. He draws the theological portion of the General Scholium to a close with the positive declaration: 'This concludes the discussion of God, and to treat of God from phenomena is certainly a part of natural philosophy.'[108]

But there is more. In using biblical titles of God that Newton believed were restricted to the Father,[109] and in arguing that the term 'God' is a relative term, denoting dominion and rule rather than essence and substance as in the Trinitarian conception,[110] he is revealing his heretical hand to those with eyes to see.[111] In stating that we 'have ideas of [God's] attributes', but that we do not 'have an idea of the substance of God'[112] he is not only championing an empirical understanding of God, but is also probably attacking the Trinitarian proclivity to articulate the relationship between God and Christ in metaphysical terms resting on notions of substance. Newton's presentation in the General Scholium of an omnipresent

[106] Ibid. 941–2 n. j. [107] Ibid. 942.
[108] Ibid. 943. The 1713 edition reads 'experimental philosophy'.
[109] Snobelen, ' "God of Gods, and Lord of Lords" ', 181.
[110] Ibid. 183–4.
[111] That some contemporary observers recognized oblique antitrinitarianism in the General Scholium is shown in Stewart, 'Seeing Through the Scholium'.
[112] Newton, *Principia* (Cohen-Whitman), 942.

God not only connects with his belief that absolute space is a predicate of God's spatial ubiquity, but has an antitrinitarian corollary, since in his private manuscripts Newton is adamant that it is only the Father, and not the Son, who possesses the attribute of immovability.[113] In the third edition of 1726, he strengthened his antitrinitarian argument by adding a footnote on the term 'God' in which he argues that the Bible allows for beings other than the True God to be called God, as in Psalm 82 where the Hebrew magistrates are called 'gods' (Hebrew *'elohim*) due to their role representing the True God.[114] As any astute contemporary theologian would have known, this was a standard argument of antitrinitarian exegetes. Another insertion in the 1726 edition further bolstered the antitrinitarian argumentation of the General Scholium. In following the statement 'Every sentient soul, at different times and in different organs of senses and motions, is the same indivisible person' a few lines later with the declaration 'God is one and the same God always and everywhere',[115] Newton both manages to enshrine the Jewish and unitarian Christian expression of faith 'God is one' ('*Deus est unus*') in the *Principia*, and imply the unipersonality of God—a heretical tenet. Viewed in this antitrinitarian light, Newton's earlier insinuation about the unity of creation being founded on the unity of God takes on an added significance.

After concluding the overtly theological portion of the General Scholium, Newton turns to natural philosophical method. In acknowledging that he has 'not yet assigned a cause to gravity', he argues that it is enough that he can describe it mathematically. Although he does not mention Descartes directly, it is clear that the French natural philosopher is one of his targets when he avers that he will not resort to vain hypothesizing in his famous declaration: '*hypotheses non fingo*' ('I do not feign hypotheses'). He adds: 'For whatever is not deduced from the phenomena must be called a

[113] Newton, Keynes MS 8. Newton's unitarian conception of space can be contrasted with the Lutheran Johannes Kepler's Trinitarian conception of the universe, in which the Father is associated with the Sun, the Son with the fixed stars, and the Holy Spirit with the intervening space (Robert S. Westman, 'The Copernicans and the Churches', in David C. Lindberg and Ronald L. Numbers (eds.), *God and Nature: Historical Essays on the Encounter Between Christianity and Science* (Berkeley: University of California Press, 1986), 97).

[114] Newton, *Principia* (Cohen-Whitman), 941 n. g. [115] Ibid. 941.

hypothesis; and hypotheses, whether metaphysical or physical, or based on occult qualities, or mechanical, have no place in experimental philosophy'.[116] Finally, Newton concludes the General Scholium with a short paragraph on 'a certain very subtle spirit pervading gross bodies and lying hidden in them'. Newton is certain of the existence of this spirit and, although he is not certain of the nature of its operations, he wants to suggest that it can explain the forces of attraction between both small and large bodies. It is his antidote to excessive mechanism. Its inclusion in a document that also speaks openly about God's omnipresence is also more than suggestive. This spirit must be taken as an integral element of his natural philosophy, which, as is sketched out in the General Scholium, has God as its focal point.

The General Scholium serves as public testament to Newton's agendas for natural philosophy and theology, even though these agendas are accessible only to the highly adept reader. Not only is Newton at pains to champion an inductive natural philosophy and to stress that 'to treat God from phenomena is certainly part of natural philosophy', but he implies that a correct understanding of God will jettison Trinitological formulations. Ultimately for him, hypotheses in natural philosophy and religion lead to corruption. Newton's natural philosophy and his heretical theology are also linked by this methodology. Just as a humble and inductive reading of the Book of Nature leads one to the Creator, so a humble and inductive reading of the Book of Scripture leads one to the One True God of the Bible. The two reformations come together in the General Scholium.

THE TRUE RELIGION AND 'NATURAL PHILOSOPHY IN ALL ITS PARTS'

Even after the publication of the General Scholium in 1713 Newton continued to toy with additional revelations in print. In one of the unpublished draft prefaces of the *Principia* composed in the years after the release of the second edition, Newton outlines his natural philosophical method and summarizes some of the content of his

[116] Ibid. 943.

magnum opus. As Cohen notes, this draft preface 'is of special interest because it sets forth clearly what Newton considered to be the goals and achievements of the *Principia*'.[117] One passage not only provides a synopsis of the Classical Scholia, but explicitly states that Newton believed he was merely reviving the lost philosophy of the ancients:

> The Chaldeans long ago believed that the planets revolve in nearly concentric orbits around the sun and that the comets do so in extremely eccentric orbits, and the Pythagoreans introduced this philosophy into Greece. But it was also known to the ancients that the moon is heavy toward the earth, and that the stars are heavy toward one another, and that all bodies in a vacuum fall to the earth with equal velocity and thus are heavy in proportion to the quantity of matter in each of them. Because of lack of demonstrations, this philosophy fell into disuse, and I did not invent it but have only tried to use the force of demonstrations to revive it.[118]

Thus, while the *Principia* was to provide the demonstrations that the ancients had not been able to provide, its philosophy was not new, but rather a restoration of the original philosophy that had been lost.

But it was not only the ancient natural philosophy that had been lost and corrupted and thus required restoration. Moral philosophy was also in need of reformation. And this reformation was related to the reformation in natural philosophy, as Newton concludes in the final paragraph of Query 31:

> And if natural Philosophy in all its Parts, by pursuing this Method, shall at length be perfected, the Bounds of Moral Philosophy will be also enlarged. For so far as we can know by natural Philosophy what is the first Cause, what Power he has over us, and what Benefits we receive from him, so far our Duty towards him, as well as that towards one another, will appear to us by the Light of Nature.[119]

Since the pure natural philosophy led inductively to an understanding of the Creator, this reformation is in turn related to one in religion—which would be an undoing of the corruption and idolatry of the Gentiles who had departed from the original religion of the Noachides:

[117] Cohen, 'Guide', Ibid. 49.
[118] Newton in Cohen, 'Guide', Ibid. 49.
[119] Newton, *Opticks*, 405. The wording is the same in the 1717 edn.

And no doubt, if the Worship of false Gods had not blinded the Heathen, their moral Philosophy would have gone farther than to the four Cardinal Virtues; and instead of teaching the Transmigration of Souls, and to worship the Sun and Moon, and dead Heroes, they would have taught us to worship our true Author and Benefactor, as their Ancestors did under the Government of Noah and his Sons before they corrupted themselves.[120]

And the worship of 'our true Author and Benefactor' was the ultimate purpose of Newton's natural philosophy.

In the introduction to a collection of essays that treat several of the themes outlined above, McGuire eloquently outlines the importance of the ancients to Newton's intellectual project:

> For Newton, the incorporation of ancient wisdom into his vision of nature is more than a ritualistic deference to tradition: it constitutes an active appropriation of tradition into the structure of his understanding of nature. As Newton construes it, understanding comprises more than sets of propositions linked together into chains of argument, or the active comprehension of the content either of propositions or occurrent mental states. For him, it is an event dynamically poised at the cognitive interface between historical patterns emerging from those embodiments. Indeed, for Newton, tradition is a cultural appropriation that both enables and limits innovative thought. It does not exist passively in an objectified past, but actively in the very interstices of intellectual life. Thus, the transformation of *renovatio* into *innovatio* involves an active interrogation of a living past by a mind at liberty to think.[121]

For McGuire, then, it is not merely the case that Newton believed the thought of the ancients adumbrated his own understanding of nature, but that there is a very real intellectual relationship between Newton's reading of ancient natural philosophy and the cognitive content of his own natural philosophy. Thus McGuire claims both a weak relationship between ancient wisdom and Newton's natural philosophy (that the *prisca* tradition was a part of the *context* of Newton's mathematics, optics, and physics), as well as a strong relationship (that the *content* of Newton's mathematics, optics, and

[120] Ibid. 405–6. The concluding statement 'as their Ancestors did under the Government of Noah and his Sons before they corrupted themselves' was added to the 1721 edn.

[121] J. E. McGuire, *Tradition and Innovation: Newton's Metaphysics of Nature* (Dordrecht: Kluwer, 1996), pp. xi–xii.

physics was in part shaped by his reading of the ancients). This chapter has added weight to these conclusions.

Throughout much of his adult life, Newton pursued two reformations, one in natural philosophy and one in religion. The results of the natural philosophical reformation have long been known to the world due to their publication in the *Principia* and the *Opticks*. Because his theological reformation involved the deepest heresy, he chose not to bring the results of this reformation to the public—at least not openly. In both reformations, the ancients were his constant guide. And, just as he believed the ancient Babylonian magi integrated religion with their study of nature, so, too, Newton believed that the ideal for his age was a unified philosophy that brought together the studies of the Book of Nature and the Book of Scripture. Although neither the initial editions of the *Principia* nor the *Opticks* made explicit his programme to recover the *prisca sapientia* and the *prisca theologia*, he had become committed to these twin goals, and the close relationship between them, before he began to compose the first of them. It is now known that he considered releasing more explicit affirmations with the first edition of the *Principia* (in the suppressed *System of the World*) and in the first edition of the *Opticks* (in the unused draft preface). Shortly after the publication of the *Principia* he composed the Classical Scholia for a projected second edition. Although this material remained unpublished, brief hints of the arguments contained therein, and much else besides, including a forceful affirmation of natural theology and the centrality of God to natural philosophy, did make their way into the General Scholium of 1713. As for the *Opticks*, only two years after the first edition was released, the natural theology and the *prisca sapientia* were displayed in the new Queries of the *Optice* of 1706. The presence of these commitments in Newton's private writings long before his great works went through the press shows that they are not merely rhetorical ornamentation. Queries 28 and 31 and the General Scholium, found at the conclusions of his books and thus helping to establish their overall purpose, open a window on his private thoughts, even if the window is open only a crack and the hidden meaning still partially obscured by a veil of oblique phrases meant to restrict the meaning to the worthy.

It was Newton's desire to construct a natural philosophy that demonstrated that nature was contingent on the existence of God, whether this be the beauty and symmetry seen in creation or the grounding of absolute space and time in God's omnipresence and eternal duration. Newton's God of dominion and his view of nature as dependent on God are two halves of a whole. And the correct understanding of each was the result of a right reading of the Books of Nature and Scripture respectively. Athanasius and the Homoousians had brought about an apostasy in religion by infusing metaphysics and doctrinal novelties into religion. Descartes and other mechanical philosophers had taken the wrong path in natural philosophy, a way of corruption and human pride that would yield philosophical romances in place of the truth of nature. Hypotheses had yielded substance talk and the abomination of the Trinity in religion, just as it had led to solid orbs and vortices in natural philosophy. Both were forms of idolatry. Furthermore, a pure natural philosophy and method led to the First Cause—not as a foundational axiom or initial hypothesis as in the a priori reasoning of Cartesianism or as the conclusion of purely thought-based reasoning as in the Platonized ontological arguments of Anselm, but in the inductive a posteriori reading of nature inspired in part by the Hebraic-biblical intuition that works backwards from the beauty, order, and unity of nature to the One true God. Descartes's method was the inverse of the method that resulted in truth about nature and God. Newton was intent on developing a physics for all time for which God was not merely a pious overlay, but that demonstrated that he was the personal power and source behind all nature. That Newton believed his radical theology was thoroughly bound up with this natural philosophy is made plain by the juxtaposition of his covert attack on the Trinity and his natural philosophical apologetics in the General Scholium.

There is one remaining curiosity. Why the asymmetry between the release of the results of the natural philosophical reformation and the secrecy enshrouding the religious reformation? While his publication of the *Principia* and the *Opticks* suggests that he felt that the time was ripe to bring the reformation of natural philosophy to the wider world, Newton did not believe the original Gospel or pure monotheism would be preached openly and successfully for two centuries

or more after his passing. And yet he was sure that this day would eventually arrive. Perhaps this is one reason why he risked exposure by heretic-hunters and embedded his heretical theology in the General Scholium to await the time to come when they would be understood.