THE READING OF NEWTON IN THE EARLY EIGHTEENTH CENTURY: TORIES AND NEWTONIANISM

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The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others.

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Abstract

This dissertation examines Tory High-Church and Jacobite Episcopalian responses to Newton in early eighteenth century England and Scotland, providing a systematic analysis of the relationship between Newtonian natural philosophy, politics and religion from a Tory High-Church perspective. I argue that historical understanding of the linkages between political/ religious groups and Newtonian natural philosophy in the early eighteenth century can be improved by extending current historical debate beyond existing scholarship on the politics of Newtonianism – scholarship which has sought to establish a close relationship between Whigs, Latitudinarians and support for Newton. Instead of assuming a fixed association between political and religious groups and support for Newton, this thesis illustrates the multi-faceted nature of Newtonianism and the diverse political and religious uses to which Newtonian natural philosophy could be put. Tories and Jacobites frequently used Newton's science in political and religious debate to defend Tory High-Anglicanism and Scottish Episcopalianism, in spite of the numerous examples of Tory High-Church natural philosophers who saw Newton and his followers as exponents for radical Whiggery and heterodox thought, especially anti-Trinitarianism. This thesis seeks to understand how and why Tories and Jacobites had these various and often conflicting opinions of Newton. By doing so more complex and thorough knowledge of the support and opposition to Newton during this period can be gained, along with a better historical understanding of the triumph of Newtonian natural philosophy over rival philosophical systems.

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Introduction

This thesis analyses Tory High-Church responses to the ideas of a seminal figure of early modern British natural philosophy Isaac Newton, and offers a Tory High-Church view of intellectual change in late seventeenth and early eighteenth century Britain. An examination is made of the reactions to Newton, both pro and con, by Tory and Jacobite natural philosophers from the publication of the *Principia* in 1687, through successive editions of the *Principia* and the *Opticks*, until shortly after Newton's death in 1727. Such an historical inquiry is important given the lack of thorough understanding of the range of responses to Newton during this period, both pro and con. The Tory natural philosophers in this thesis were introduced to Newtonian natural philosophy during Newton's lifetime, but they held widely different opinions of the man and his natural philosophy. For example, while the Jacobite Scots Archibald Pitcairne and David Gregory saw Newtonian natural philosophy as useful in the defence of hierarchy in battling against Presbyterian enthusiasm, their students at Oxford – John Keill, John Freind and John Arbuthnot – emphasized Newton's modesty, reverence for the ancients and religious piety. By contrast, several within the Tory fold, such as Robert Greene, George Berkeley, Roger North and John Hutchinson, saw Newton as an exponent of materialist mechanism and religious heresy. Their interpretations were given credence by Newton's speculations, principally in the Latin *Optice*, on matter theory, attractive powers and space and time, and were reinforced by the radical uses to which Newton was put by English republicans and deists, like John Toland, and by the public anti-Trinitarianism of Newton's

disciples Samuel Clarke and William Whiston. This dissertation will examine these various readings with the goal of differentiating them, and of explaining the differences, in order to achieve a more complex and refined historical account of the nature of support for and opposition to Newton among Tory natural philosophers.

Historiography and the politics of science in early modern England

An analysis of Tories and Jacobites in early eighteenth century Britain and of their responses to developments in natural philosophy is much needed in the light of recent research by a number of scholars. Political and religious historians of eighteenth century Britain have recognised the persistence of Tory/Jacobite and High-Church views on kingship and the ecclesiastical establishment after 1688.[1] Such works have revealed that Tories and their English and Scottish religious allies – High-Churchmen and Episcopalians – strongly influenced the political and religious debates of the period. Contrary to historians such as Christopher Hill who have interpreted the events of 1688 as a triumph for Whig bourgeois values – that is, for the emergence of parliamentary sovereignty, limited monarchy, capitalism and Latitudinarianism within the Anglican Church, recent scholarship has revealed how Tory High-Church beliefs remained strong after 1688. As Jonathan Clark has emphasised, the overthrow of James II did not represent the triumph of religious toleration, free speech and contractual government. Britain remained a confessional society dominated by the monarchy and the Anglican Church. Tory High-Church views on kingship and the ecclesiastical establishment which strongly defended royal prerogative against

the radical Whig promotion of Lockean contract theory, and the Anglican Church against the Latitudinarian or Low-Church toleration of religious nonconformity, stubbornly persisted.[2] The Scientific Revolution occurred in a society dominated by conservative patrician elites.

The relationship between Tory intellectuals and natural philosophy has unfortunately been ignored. Too often Tories and High-Churchmen have been portrayed as yesterday's men opposed to everything new and modern, and the rise of science has been tied to political and religious groups who, from the vantage point of the twenty-first century, have been viewed as agents of political and social progress. The responses of Tories to the new science, especially to Newton's works and ideas are important and merit historical investigation, because they add to our understanding of the relationship between science and political/religious change during this period. This section will offer a brief examination of attempts to link the rise of science in Britain to specific political and religious groups before proceeding to a general discussion of the methodology of this dissertation and the outline of the thesis.

(a) Merton, Webster, Hill and Shapiro

The first major attempt to explain the Scientific Revolution in England by reference to political, religious and social contexts was made by Robert Merton. In 1938 he postulated a strong link between the growth of Puritanism in early seventeenth century England and the rise of experimental and utilitarian science.[3] Taking his cue from the suggestions of Max Weber that religious values, especially Protestantism, influenced the rise of capitalism in Western Europe,

Merton extended this thesis to include science. He argued that the cultural or religious ethos of Calvinist Puritanism, with its emphasis on good works, public service, utility, labour and industry, encouraged scientific activity and was the motive force that impelled many individuals to choose science as a vocation. Science became a means to glorify God and to prove one's membership of the elect. In the mid 1970s Charles Webster extended Merton's Puritan science thesis to include an analysis of Samuel Hartlib, John Dury, Robert Boyle and John Wilkins, as well as other natural philosophers labelled as Puritan. Webster emphasised how Puritan advocates for a reformation of knowledge, especially Hartlib and Dury, believed this reformation would signal the beginning of the millennium, and he illustrated the close links between Puritan reformers and millenarianism. Christopher Hill's *Intellectual origins of the English revolution* and *World turned upside down* also championed the Puritan-science thesis as a further manifestation of the seventeenth century Puritan revolution.[4]

Thirty years after Merton published his provocative study Barbara Shapiro offered a sustained critique of Merton, while at the same time providing an alternative explanation for the rise of science in mid-seventeenth century England that would be subsequently modified by James and Margaret Jacob. Instead of Puritanism, Shapiro associated most natural philosophers with Low-Church or Latitudinarian liberal Anglicans who sought reconciliation between the warring religious factions of the mid seventeenth century by seeking to encompass religious nonconformists within the Anglican Church. Instead of characterising natural philosophers such as Robert Boyle and John Wilkins as Puritans she grouped them with a "broad middle category of divines, scholars, and politicians who wanted mild reforms in the church and sought moderate means of

accomplishing them."[5] By promoting a few tenets of religion necessary for salvation and discoverable through the light of reason, Latitudinarians became exponents of a rationalized religion, natural theology and the new experimental philosophy. For Shapiro it has seemed almost irresistible to link the decline of scholastic authority and the rise of experimental science with liberal values. Toleration and freedom of inquiry, especially from the obtrusiveness of political interest and religious dogma, has been seen as essential for the growth of experimental science. Indeed, for Shapiro Latitudinarianism represented the end of ideology.

(b) The Jacob Thesis

In their works of the late 1970s James and Margaret Jacob modified Shapiro's thesis. While Shapiro viewed Latitudinarianism as essentially apolitical, the Jacobs connected liberal Anglicanism and natural philosophy to the defence of Whig and capitalist interests. Influenced by Marxist theory, as was Boris Hessen in his analysis of the economic roots of Newton's *Principia*,[6] the Jacobs saw the dominant natural philosophies of the Restoration and post-revolutionary periods as ideological weapons designed to defend the bourgeois political and economic establishment that emerged after the civil wars of mid-century. On this account the natural philosophies of Boyle and Newton were constructed and used to support capitalist society against the radical pantheist philosophies of civil war radicals, republicans, deists and freethinkers. Correspondingly the union of Whiggery, Latitudinarianism and Newtonian natural philosophy meant that Tory High-Churchmen were either anti-Newtonian and or anti-science.[7]

The writings of the Jacobs provide good examples of the application of Marxist theory to the history of science. Their works advance an historical teleology that connects the development of science to the emergence of modern political, religious and social groups, part of the process that led to the creation of the modern bourgeois state. A deterministic taxonomy relating politics and religion to natural philosophy is argued for: defenders of the old order – royalists, Tories and High-Churchmen – are opposed to new natural philosophies including that of Newton, supporters of the Whig establishment promote Newton and use his natural philosophy to justify the post 1688 capitalist socio-economic order, and radicals, who desired a more radical revolution during the Interregnum and in 1688, advance radical philosophies of nature, sometimes even perverting Newton's writings in the pursuit of such ends.

(c)Responses to and advances on the Jacob thesis.

The Jacob thesis has led to much subsequent debate about the politics of science in late seventeenth and early eighteenth century England. Much work published in the 1980s has confirmed the Jacobs' conclusions of a close link between the rise of modern science, Whiggery and liberal Anglicanism. While not necessarily seeing Boyle or Newton as apologists for a Whig bourgeois social and economic order, works like Shapin and Schaffer's famous study of the dispute between Hobbes and Boyle and John Gascoigne's examination of science at Cambridge have reinforced the notion that the leaders of the Scientific Revolution in England were men of moderate political and religious views who opposed the radicalism of the civil war sects and the absolutism of Tory divine

right theorists.[8] Although Shapin and Schaffer's study of the Hobbes-Boyle dispute is more concerned with defending the claims made by the strong programme in the sociology of knowledge than with defending the Jacob thesis, their conclusions fit nicely within the classificatory scheme established by the Jacobs.

Anti-Newtonian scholarship has also been greatly influenced by Margaret Jacob's assertion that Tory High-Churchmen are anti-Newtonian and or anti-science, indicating the great impact of her work on the study of Newton's opponents as well as supporters. The works of several historians of science on Tory High-Church critics of Newton reveals her influence. Indeed, anti-Newtonian scholarship has focussed on opposition to Newton with the specific aim of illustrating how Tory High-Churchmen associated Newton and his followers with Whigs and Latitudinarians. For example, Larry Stewart has shown how several High-Churchmen such as Roger North made links between Newton's natural philosophy, especially as found in the General Scholium, with the Arianism of Samuel Clarke and William Whiston. Marina Benjamin and Chris Wilde have provided interesting analyses of the Tory High-Church roots of George Berkeley's and John Hutchinson's opposition to Newton. Both have shown how Berkeley and Hutchinson believed Newton, by attributing attractive powers to matter, had made motion essential in matter, thus supporting heretical pantheist anti-clerical thought.[9] While the works of Stewart, Benjamin and Wilde have shown that Tory High-Church opponents of Newton were enthusiasts for alternative natural philosophies, and therefore cannot be classified as anti-science, they have broadly adopted the Jacobs' conclusion that Newtonians are Whigs and anti-Newtonians Tories. The work of Richard Olson, in his analysis of the High-

Churchmen Jonathan Swift, John Arbuthnot and Samuel Johnson, also demonstrates the Jacobs' influence, but from a different angle. While declaring that Swift, Arbuthnot and Johnson cannot be classified as anti-Newtonian, Olson instead labels them as anti-science.[10]

Critics of the Jacobs such as Michael Hunter and Anita Guerrini have rightly noted the political and religious diversity of scientific practitioners during the Restoration and post-revolutionary periods; they have demonstrated how Tories/ Jacobites and High-Churchmen/ Episcopalians, as well as Whigs and Low-Churchmen, promoted new experimental philosophies, including that of Newton. Both scholars have noted the heterogeneous nature of English and Scottish natural philosophy. For example, in his studies of Restoration science and the early Royal Society, Hunter challenged the claims of the Jacobs that natural philosophy was used to promote a bourgeois capitalist economic order. He has shown that the Royal Society (with the exception of men like Robert Hooke) was composed mainly of landed gentlemen, not merchants and artisans; it contained among its membership royalists such as Seth Ward and Christopher Wren, and practised many different types of science from the inductive experimentalism of Bacon to the mathematical theoretical science of Descartes and Galileo and later Newton.[11] Focussing on the post-revolutionary period, Guerrini identified a group of Jacobite Scottish Episcopalians Newtonians led by Archibald Pitcairne and David Gregory and noted the subsequent formation of a Tory Newtonian circle at Oxford. This seemingly bi-partisan, cross party support for Newton provided evidence to Guerrini that Jacob's notion of a Whig Newtonian ideology was deeply flawed,[12] and can be seen to add support to the intellectualist accounts of the Newtonian revolution provided by earlier Newtonian scholars

such as I. Bernard Cohen, Alexander Koyre, Robert Schofield and Arnold Thackray that examined scientific debate largely independently of political and religious contexts.[13]

Method

Both the advocates for a determinist causal relationship between particular political, social and religious groups and support for Newtonian natural philosophy, and those who have viewed cross party support for Newton, both political and religious, as evidence for the limited role of political, social and religious factors in past judgements of Newton, base their conclusions on certain misconceptions. While the Weberian and Marxist attempts to link specific natural philosophies to the rise of Puritanism and the defence of Whig socio-economic interests largely ignore empirical evidence to the contrary, such as the existence of Tory/ Jacobite Newtonians in Scotland, critics often hastily conclude that political and religious allegiances of natural philosophers have played little part in their acceptance and support for various natural systems. I will argue that a new approach to this problem is required -- one that recognises the role of external factors but does not ascribe a necessary connection between political and religious allegiances and natural philosophical commitments. Instead I will assign positive roles for external factors, but ones that are not necessarily uniform, and which are relative to time and place and variable depending on individual judgements.

I will analyse the various interpretations or readings of Newton by Tory High-Church natural philosophers in the early eighteenth century. These contested

readings indicate to the historian the difficulties of postulating a simple causal connection between support for a political and religious group and adherence to a specific natural philosophy. Instead, I will argue that one must understand the variety of views among Tory High-Church natural philosophers and their supporters in Scotland and England by reference to the local, institutional and chronological contexts in which they wrote along with the personalities and individual ambitions of authors. While critiques of Newton in the early eighteenth century came from Tory High-Churchmen disillusioned with the post-revolutionary settlement, revealing a convergence between Tory and High-Church political and religious views and opposition to Newton, Newtonian natural philosophy could also be appropriated by Tories to defend a hierarchical society of social orders, battle religious and political sectarianism and to defend the Anglican Church against deists and freethinkers. A close differentiation of the relevant external factors is required to account for this diversity.

These multiple readings of Newton illustrate that Newtonianism has many faces. The term itself is problematic. Newton's writings were often interpreted in ways that he did not intend and that were inconsistent with his own beliefs. These factors were further complicated by Newton's own hesitancy to make clear conclusions about crucial questions in natural philosophy such as the cause of gravity and his relegation of such problems in his works to Queries in the *Opticks*. This dissertation will use the terms 'Newtonian' and 'Newtonianism' in a flexible manner in recognition of the various opinions that individuals and groups of scholars had of Newton and his natural philosophy.

The inchoate nature of Newtonianism is principally due to differences between the *Principia* and the *Opticks*, and Newton's subsequent additions to

these works, especially the latter. While the *Principia* (1687) offered a mathematical analysis of terrestrial and celestial motion that refrained from speculating about the cause of gravity, the experimental *Opticks*, first published in English in 1704, was much more accessible to the non-specialist reader. More importantly, as I. Bernard Cohen has noted: in "the *Opticks* Newton did not adopt the motto to be found in the *Principia* – Hypotheses non fingo; I frame no hypotheses – but, so to speak, let himself go, allowing his imagination full reign and by far exceeding the bounds of experimental evidence."[14] In successive editions of the *Opticks* he added queries that speculated about the structure of matter, the cause of gravity and God's relationship to the cosmos.

Of particular importance are Queries 28 and 31 appended to the 1706 Latin *Optice* edited by Samuel Clarke.[15] In these queries Newton strongly defended atomism and a vacuum while at the same time postulating the existence of active principles in nature to explain gravity. In Query 31 he declared that God in the beginning had formed "Matter in solid, massy, hard, impenetrable, movable Particles, and in such Proportion to Space, as most conduced to the End for which he forms them."[16] He also asked at the beginning of the query:

> Have not the small Particles of Bodies certain Powers, Virtues, or Forces, by which they act at a distance, not only upon the rays of Light for reflecting, refracting, and inflecting them, but also upon one another for producing a great Part of the Phaenomena of Nature.[17]

The 1706 *Optice* revealed a cosmos actuated by active principles and that was mostly devoid of corporeal substance, one where God was immanently present and exercised His influence. Indeed, Newton declared in Query 28, that there was "a Being, incorporeal, living, intelligent, omnipresent, who in infinite Space, as it were in his Sensory, sees the things themselves intimately, and thoroughly perceives them, and comprehends them wholly by their immediate presence to

himself."[18] Similar statements concerning God were expressed in the General Scholium added to the second edition of the *Principia* (1713). It was only in the second English edition of the *Opticks* (1717) that Newton offered an ethereal explanation for gravity, but one that merged his material ether with the active principles of the earlier *Optice* and that remained largely ignored until a decade after Newton's death with the resurgence of ethereal theories in the 1730s and 40s.[19]

There were therefore multiple sources available for Tory High-Church scholars to praise or condemn Newton. While the *Principia* could be viewed as providing certain demonstrative knowledge of the laws of nature that avoided uncertain speculations about the causes of phenomena, the *Opticks*, by its postulation of attractive powers, atoms and a vacuum, could be seen to justify heretical ideas such as thinking matter and materialist philosophies like Epicurean atomism. Furthermore, Newton's statement that space was the sensorium of God in the *Optice* left him vulnerable to the charge of making God a material being.[20] As Larry Stewart and Steven Snobelen have shown, Newton's strong emphasis on God's dominion in the General Scholium could also be subject to Arian and Socinian readings.[21] Paradoxically, Newton's providential God could be interpreted as revealing the deity's miraculous power in nature, especially since Newton appeared at times to be resolving the cause of gravity to the power and providence of God. In this respect Newtonian natural philosophy could be viewed as useful to battle deism.

Different images of Newton were thus constructed during the early eighteenth century. These included: Newton the mathematical natural philosopher, Newton the modest, pious experimental philosopher and defender of the ancients, Newton

the corpuscular Epicurean materialist and speculative thinker, and Newton the vain experimentalist and anti-Trinitarian heretic with connections to radical free-thought. The images individual Tory natural philosophers constructed depended on a variety of factors, most notably the regional and institutional contexts in which they studied and wrote, the time period of their introduction to Newton (in relation to his published works) and the degree of their association with the scientific and academic establishment.

By offering a systematic examination of Tory/Jacobite support for and opposition to Newton in early eighteenth century England and Scotland, this thesis will argue that a more thorough understanding of the nature of opposition to Newton (or lack thereof) among Tory natural philosophers, as well as theologians and literary figures, can be acquired. Heretofore there has been little comparative analysis of anti-Newtonian thought in early eighteenth century England. Historical investigation has concentrated primarily on individual critics without noting the agreed and shared aspects of their opposition and how their criticisms of Newton varied.[22] Such a study will illuminate our understanding, not only of anti-Newtonianism, but also of Tory Newtonianism during this period. By reflecting on the intellectual sources for Tory High-Church discontent with Newton and the causal factors that motivated specific critics to construct alternative philosophies of nature, one can gain a better understanding of why specific Tory natural philosophers chose to pursue a different route, exploiting specific aspects of Newton's writings to promote Tory High-Anglicanism.

Structure of thesis

I have chosen to examine Tory and Jacobite natural philosophers whose support or opposition to Newton predated his death in 1727, and whose political and religious views, as well as opinions of Newton, have been subject to some previous analysis and are therefore well established. Tory and Jacobite supporters of Newton are primarily drawn from Guerrini's circle of Scottish Newtonians led by Archibald Pitcairne and David Gregory, while Newton's opponents – Robert Greene, George Berkeley, Roger North and John Hutchinson – are analysed with specific attention to historical issues that other scholars have failed to tackle, specifically the degree to which anti-Newtonians were unified in their critiques of Newton. This dissertation demonstrates that the opponents of the Whig Low-Church establishment in Britain had diverse opinions of Newton and explains why this was so.

The thesis begins with an analysis of the origins of Scottish Tory Newtoniansm. Guerrini's discovery of a circle of Tory/Jacobite Newtonians in Scotland whose members had close ties with the Scottish Episcopalian Church raises an interesting historical problem: why did Newton's anti Whig and anti-Low-Church followers emerge initially in Scotland instead of England? Chapter two represents an attempt to explain Newton's popularity among Jacobite Episcopalians like Archibald Pitcairne and David Gregory by reference to Scotland's unique political and religious contexts. By offering a comparative analysis of the Scottish and English political and religious scene, an account of Newton's popularity among Jacobite Scots is offered, one that adds to growing historical accounts of the place of Newtonian mathematical natural philosophy in

the defence of Jacobitism and Scottish Episcopalianism. Even Guerrini in a recent work has recognised the importance of politics and religion for understanding Pitcairne's and Gregory's Newtonianism.[23]

Several of Pitcairne's and Gregory's students along with Gregory himself eventually settled at Oxford and promoted certain aspects of Newtonian natural philosophy. Oxford was noted for its Tory High-Anglicanism, and of all the colleges Christ Church was the most conservative; it was the college of the leader of the High-Church movement Francis Atterbury and of the Christ Church wits, a group of Tory High-Church classicists composed of Atterbury, William King, John and Robert Freind, Anthony Alsop and George Smalridge that defended ancient learning against the vain pretensions of the moderns led by Richard Bentley and William Wotton. Chapter three demonstrates that Newtonian natural philosophy was widely studied at Tory Oxford and at Christ Church in particular. Attention is paid to the manner in which Newton's thought was appropriated by Tory natural philosophers, especially within the context of the ancients-moderns controversy, to defend the Anglican Church against anti-Trinitarians, deists and freethinkers. This positive appraisal of Newton by his Oxford disciples will also lead to a more general examination of Newton's reputation among Oxford High-Church literary men and theologians with the intention of explaining how Newton could be seen to stand above the heterodox thought of his age, and why attacks on Newton were rare and sporadic in the early eighteenth century.

Despite this positive construal of Newton by some Tories, others viewed him as an exponent of heterodox thought. Amid fears that the Anglican Church was in danger from dissenters, deists and anti-Trinitarians, and the belief that Whig Low-Churchmen were allied with religious nonconformity, some Tory High-

Churchmen saw Newton in a very different light. Chapters four to seven show that Robert Greene, George Berkeley, Roger North and John Hutchinson saw Newton as an exponent of the anti-Trinitarian heresies of his disciples Samuel Clarke and William Whiston as well as the radical Whiggery and free-thought of thinkers such as John Toland, Anthony Collins and Matthew Tindal, men who sought to use reason and natural philosophy to undermine the Anglican Church. Such an association between Newton and freethinking is not surprising given the radical use of Newtonian natural philosophy by Toland in his *Letters to Serena* (1704) to claim that motion is inherent in matter, reject the immateriality of the soul and attack religious mystery, beliefs and programmes that were also advanced by Collins and Tindal.[24] The connection of Newton to the English radical Enlightenment is significant, since freethinkers and anti-Trinitarians promoted more than just a philosophical radicalism. They also advanced a religious radicalism with ecclesiastical, ecclesiological and theological dimensions to it, a radicalism that struck at the heart of the Anglican ecclesiastical establishment, the constitutional role and function of the Anglican Church.[25] .

Chapters four to seven illustrate a common root to the disaffection with Newton among Greene, Berkeley, North and Hutchinson, but a root that brought forth variegated branches. They illustrate how Newton's writings could be linked to heretical thought, especially those of his heterodox Whig followers, and also provide a comparative analysis of the alternative natural philosophies that each anti-Newtonian constructed to counter the Newtonian threat. Such an approach highlights similar points of agreement among Newton's opponents, but also recognises the diversity and complexity of the anti-Newtonian response, leading

to a fuller and richer understanding of the intellectual resources available to attack Newton, and the degree of uniformity among the anti-Newtonian opposition.

In addition, the last four chapters also seek to explain why Greene, Berkeley, North and Hutchinson chose to challenge Newton. Through an analysis of the temporal and spatial contexts in which they wrote, their political, religious and intellectual commitments, their own personal ambitions and, from what we know of them, their individual personalities, an understanding of the origins of their opposition to Newton and its historical significance can be gained. Such knowledge helps to explain why Newton was associated by some with radical Whiggery and heterodox thought and also, in turn, aids our understanding of Tory High-Church support for Newton.

This dissertation then will paint a picture of Newton in the early eighteenth century from a Tory High-Church perspective, one that is not homogeneous. If one adopts Margaret Jacob's characterisation of Tory High-Churchmen as anti-science reactionaries opposed to everything new and modern, such a history might seem pointless. This thesis, however, illustrates the problems with making strong causal links between political and religious groups and support for particular natural philosophies. While the Latitudinarian emphasis on reason and natural theology in religious apologetics may have made them more inclined to view natural philosophy as a resource to battle religious enthusiasm than their opponents, supporters of the High-Church were no less willing to use natural philosophy to defend the Anglican establishment against anti-Trinitarians, deists and freethinkers. Greene, Berkeley, North and Hutchinson believed they were

offering real philosophical alternatives to Newton; indeed, Newtonian natural philosophy, by its postulation of attractive powers, could be seen as backward and reactionary, as reviving old Aristotelian qualities. The existence of Tory/ Jacobite Newtonians in England and Scotland also shows how political and religious conservatives could appropriate Newton for their own purposes. Rather than resisting new learning, the following chapters will show that both Newton's Tory and Jacobite supporters and opponents used natural philosophy for their own specific political and religious ends.

Jonathan Clark has cautioned historians against false antitheses that require societies to be rural or urban, modernising or traditional, democratic or monarchical, religious or secular. Liberty can be combined with monarchy, religion with science and trade with landed wealth.[26] In my opinion, errors in recent histories on the politics of Newtonianism stem from the assumption that the rise of science is antithetical to political and religious views out of step with the modern world. This has led to a neglect of studies on the Tory High-Church response to Newton. In what follows I will argue that local, institutional and chronological contexts are essential to the production of historical accounts adequate to explain the processes underlying the diversity and range of responses to Newton.

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[2] J.C.D. Clarke, *op. cit.* (ref 1). Clarke is a notable critic of Marxist and Whig histories of the eighteenth century, particularly of Hill. For a good summary of the debate between Clarke and Hill see J.C.D. Clarke, *Revolution and rebellion: state and society in England in the seventeenth and eighteenth centuries* (Cambridge, 1986). Hill's works are too numerous to list in their entirety. For a good summary of his views see his *Intellectual origins of the English revolution*, rev ed. (Oxford, 1997) and *The world turned upside down* (New York: Penguin Reprint, 1980).

[3] Robert Merton, "Science, technology and society in seventeenth century England," *Osiris*, iv (1938), 360-632.

[4] Charles Webster, *The great instauration: science, medicine and reform 1626-1660* (New York, 1975). Christopher Hill, *op. cit.* (ref 2), *Intellectual origins.....* and *The world.....*

[5] Barbara Shapiro, "Latitudinarianism and science in seventeenth-century England," *Past and present* xl (1968), 16-41, p. 19. The thesis is also advanced in her *Probability and certainty in seventeenth century England: a study of the relationships between natural science, religion, history, law and literature* (Princeton, 1983) and her more recent *A culture of fact: England, 1550-1720* (Ithaca, 2000).

[6]Boris Hessen, "The social and economic roots of Newton's *Principia*," in *Science at the cross roads: papers presented to the international congress of the history of science and technology held in London from June 29th to July 3, 1931, by the delegates of the USSR* (London, 1931), 149-212. One sees close similarities between the Jacob thesis and Hessen's Marxist analysis.

[7] See J.R. Jacob, *Robert Boyle and the English revolution: a study in social and intellectual change* (New York, 1977) and Margaret C. Jacob, *The Newtonians and the English revolution* (Ithaca, 1976). See also her *The radical enlightenment: pantheists, freemasons and republicans* (London, 1981). For a joint summary of their views see J.R. Jacob & M.C Jacob, "The Anglican origins of modern science: the metaphysical foundations of the Whig constitution," *Isis*, lxxi (1980), 251-67.

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[10] Richard Olson, "Tory High-Church opposition to science and scientism in the eighteenth century: the works of John Arbuthnot, Jonathan Swift and Samuel Johnson," in John Burke (ed.) *The uses of science in the age of Newton* (Berkeley, 1983), 171-204.
[11] See in particular Hunter's *Science and society in Restoration England* (Cambridge, 1981). Hunter's conclusions have been further articulated in *Establishing the new science: the experience of the early Royal Society* (Woolbridge, 1989).
[12] Anita, Guerrini, "The Tory Newtonians: Pitcairne, Gregory and their circle," *Journal of British studies*, xxv (1986), 288-311. She also her PhD thesis "Newtonian matter theory, chemistry and medicine, 1690-1713," PhD. Thesis, University of Indiana, 1983.
[13] I. Bernard Cohen, *Franklin and Newton. An inquiry into speculative Newtonian experimental science and Franklin's work in electricity as an example thereof* (Philadelphia, 1956); Alexander Koyre, *Newtonian studies* (Cambridge, 1965); Robert Schofield, *Mechanism and materialism. British natural philosophy in an age of reason* (Princeton, 1969); Arnold Thackray, *Atoms and powers. An essay on Newtonian matter theory and the development of chemistry* (Cambridge, Mass, 1970).
[14] See I. Bernard Cohen's preface © 1979 to Isaac Newton, *Opticks*, ed. E.T. Whittaker (New York, Dover reprint, 1952), xxii. Whittaker's edition is based on the fourth edition published in 1730. All subsequent references to the *Opticks* are to this edition.
[15] The first English edition (1704) contained 16 queries and the Latin edition (1706) a further 7, which were revised in the second English edition (1717) to become queries 25-31 in succeeding editions.
[16] Isaac Newton, *op. cit.* (ref 14), 400.
[17] *Ibid.*, 375-76.
[18] *Ibid.*, 370.
[19] For the influence of Newton's *Opticks* on experimental natural philosophy in the eighteenth century see Robert Schofield, *op. cit.* (ref 13), esp. chap. 1. Schofield's assertion that Newton's ethereal hypothesis represented a move away from active principles and toward mechanistic contact action explanations for gravity has been challenged by P.M. Heimann. See his "Nature is a perpetual worker: Newton's aether and eighteenth-century natural philosophy," *Ambix*, xx (1973), 1-25. For the importance of the *Optice* in relation to Newton's matter theory see Arnold Thackray, *op. cit.* (ref 13), esp. chaps 1-3.
[20] In his first letter to Clarke, Leibniz stated: "Natural religion itself, seems to decay (in England) very much. Many will have human souls to be material: others make God himself a corporeal being." H.G. Alexander (ed.), *The Leibniz-Clarke correspondence* (Manchester, 1956), 11.
[21] Larry Stewart, *op. cit.* (ref 9), "Seeing through…..". Steven Snobelen, "Isaac Newton, heretic: the strategies of a Nicodemite," *British journal for the history of science*, xxxii (1999), 381-419.
[22] See note 9
[23] For these previous accounts see Andrew Cunningham, "Sydenham vs Newton: the Edinburgh fever dispute of the 1690s," in W.F. Byrum and V. Nutton (eds), *Theories of fever from antiquity to the Enlightenment* (London, 1981), 71-98; Steven Stigler, "Apollo Mathematicus: a story of resistance to quantification in the seventeenth century," *Proceedings of the American Philosophical Society*, cxxxvi (1992), 93-126; Simon Schaffer, "The Glorious Revolution and medicine in Britain and the Netherlands," *Notes and records of the Royal Society of London*, xliii (1989), 167-90. In her recent biography of George Cheyne, Guerrini has recognized the importance of the Scottish political and religious context for understanding Pitcairne's and Gregory's Newtonianism. See her *Obesity and depression in the Enlightenment: the life and times of George Cheyne* (Norman, 2000), esp. chap. 2-3.

[24] For Toland see Stephan H. Daniel, *John Toland. His methods, manners and mind* (Kingston, 1984). For the influence of Spinoza on English radical thought see Jonathan Israel, *Radical enlightenment. Philosophy and the making of modernity, 1650-1750* (Oxford, 2001), chap. 33. Other accounts of English freethought can be found in Roy Porter, *The enlightenment. Britain and the creation of the modern world* (London, 2000), chap. 5 & Margaret Jacob, *op. cit.* (ref 7) *The radical.....*, chaps 1-3.
[25] See especially J.A.I. Champion, *The pillars of priestcraft shaken. The Church of England and its enemies* (Cambridge, 1992).
[26] Jonathan Clarke, *op. cit.* (ref 1), 14-15.

Archibald Pitcairne, David Gregory and the cultural origins of early Scottish Newtonianism

In response to the strong assertions made by Margaret Jacob of a firm connection between Whiggery, Latitudinarianism and support for Newtonian natural philosophy, historians of science have recently noted the many Tories/ Jacobites in both England and Scotland who were supporters of Newton.[1] Anita Guerrini's examination of a group of Scottish Newtonians led by David Gregory and Archibald Pitcairne and including men like James and John Keill, George Cheyne, William Cockburn, John Arbuthnot and George Hepburn has been instrumental in this respect.[2] Guerrini has showed that these men were from Scottish Episcopalian backgrounds, inclined toward Jacobitism and had close connections to English Tories and High-Churchmen such as the Oxford physician John Freind. More recently there have been attempts by Guerrini and others to explain how the political and religious views of the above group were related to their support for Newtonian natural philosophy. For example, J.R.R. Martin has shown how Freind believed Newtonian medicine represented a return to ancient medical practise; Newtonian physic was thus not innovative or revolutionary but supportive of traditional learning.[3] Simon Schaffer has argued for a close link between Jacobite politics and Newton's *Principia* in the case of Pitcairne. In Schaffer's opinion, Pitcairne believed mathematics secured certain knowledge, knowledge that countered the speculations of Cartesians and other natural philosophers that bred dissent and faction in philosophy and politics.[4] Building upon her previous work, Guerrini has argued for a close correlation between Pitcairne's mathematical medicine and his authoritarian politics. She has

persuasively argued that Pitcairne viewed mathematical learning as a useful antidote to Presbyterian enthusiasm and as advancing such doctrines as the divine right of kings; these opinions were communicated to Pitcairne's disciple George Cheyne.[5]

However, what has yet to be adequately explained is why most of the Tory or Jacobite Newtonians in the early eighteenth century came from Scotland instead of England. To answer this question attention in this chapter will be paid to the unique Scottish political and religious context that made Scotland a fruitful place for Newtonian ideas after the Glorious Revolution, highlighting the differences between Scottish Episcopalians and English High-Churchmen on issues such as the relationship between faith and reason. Central to my argument is that Scottish Episcopalians, like English Latitudinarians, put great emphasis on the use of reason to combat religious enthusiasm, while English High-Churchmen viewed the promotion of reason at the expense of faith as leading to the proliferation of religious dissent and freethinking.

In this chapter primary focus will be on the Newtonians David Gregory and Archibald Pitcairne. As enemies of the post 1688 political and religious settlement in Scotland, they opposed the re-establishment of Presbyterianism and the placing of a Dutch king William of Orange on the Scottish throne. Both Gregory and Pitcairne saw natural philosophy, especially Newtonian natural philosophy, as a useful antidote to religious enthusiasm and sectarian violence.[6] Newton's mathematical system of the universe provided a model for order in both the worlds of philosophy and politics that avoided endless disputes about uncertain hypotheses. In the case of Pitcairne, the introduction of mathematical methods into medicine served as the basis for new medical theories useful in

battles against the naïve practises of empirics and speculative medical theorists such as the Whigs Andrew Brown and Edward Eizat. Pitcairne and his disciples George Cheyne, George Hepburn, John Cockburn and John Arbuthnot believed mathematical physicians were members of an elite caste; their opponents were the ignorant vulgar whose uncertain hypotheses led to faction and disorder in medicine and society at large.

England, Scotland and the origins of the Scottish Enlightenment

In order to understand why many historians like the Jacobs have viewed English High-Churchmen as hostile to Newton the terms High-Church and Low-Church must be defined in respect to post 1688 English politics. Although English Tories and High-Churchmen were political allies of Scottish Episcopalians, I will argue that the receptivity of Scottish Episcopalians to new philosophic ideas, whether Cartesian or Newtonian, in the late seventeenth century, was greater than that of their English High-Church counterparts. This was largely due to the way in which High-Church Anglicans feared that the Church of England was in danger from the heterodox uses of natural philosophy while the enemies of Episcopacy in Scotland, the Presbyterians, were viewed as particularly hostile to the new learning. Knowledge of the political and religious context in each kingdom is vital for understanding the enthusiasm for Newton among many Scot Episcopalians or, in other words, the cultural origins of early Scottish Newtonianism. These contexts need to be explored and contrasted.

In England the post-revolutionary period saw the nation divided into Whigs and Tories. While the former received their support from Low Church Anglicans

the latter were tied politically to the High-Church. While scholars such as Jonathan Clark have emphasised how Whigs and Tories shared similar assumptions about social hierarchy, dynastic legitimism and the religious establishment, the late Geoffrey Holmes' assertion that "whatever the complexities of the body politic in the early years of the eighteenth century, its life-blood was the existence and conflict of two major parties" is a more accurate characterisation.[7] Despite the wide existence of hierarchical political and social values throughout English society, divisions over how best to maintain political and religious stability after 1688 resulted in much political and religious dispute. Whigs and Tories were at odds over such vital issues as the true nature of kingship and the post-revolutionary religious settlement. While Whigs were more willing to put limits on the rights of kings and believed in the right of rebellion in extreme circumstances, Tories continued to support the doctrines of passive obedience and non-resistance after 1688 despite abandoning their previous support for the absolute monarchy and indefeasible hereditary succession in the Restoration.[8] The Tories were known as strong supporters of the Anglican Church and as opponents of the Toleration Act. It was over issues of religion that the distinction between Whig and Tory was most acute. In the words of Holmes, "the strongest threads of continuity between the original parties of Charles II's reign and the post-Revolution Whigs and Tories were those of religious principle. The Whigs continued to regard themselves as guardians of the Toleration Act; the Tories remained jealously watchful for any further erosion of the privileged position still left to the Establishment by the act of 1689."[9]

Not surprisingly, therefore, the Tories became intimately associated with the High-Church party and the Whigs with the Low-Church party or Latitudinarians.

High-Churchmen believed strongly that those who remained outside of the Anglican Church were separated from God and saw the Church of England as independent of state control. In their opinion, the church was governed by a divinely ordained hierarchy of bishops, priests and deacons whose authority was necessary for the fulfilment of the sacraments. In contrast, some Low-Churchmen went so far as to see the church as a voluntary society and subordinate to the state. They put less emphasis on matters of doctrine and ceremony, on what they termed the inessentials of faith, and more on those few essentials thought necessary for salvation, such as the belief in God and his providence, in order to find some point of unity with the English Nonconformists.[10] Perhaps the biggest difference between High-Churchmen and Low-Churchmen was one of ethos. High-Churchmen held their views much more rigidly and they were willing to use all resources, including Convocation, to censor and condemn unorthodox views. Low-Churchmen were much less willing to go to such extremes.[11]

Latitudinarians put considerable emphasis on reason and natural theology in religious apologetics and have been viewed by historians of science as enthusiasts for natural philosophy while High-Churchmen have been labelled the exact opposite. As mentioned in the introduction, beginning with Barbara Shapiro and continued with Margaret and Jim Jacob there have been numerous attempts to link the rise of science and the triumph of Newtonianism with liberal Anglicanism.[12] In contrast, Tories and High-Churchmen have been viewed as either anti-science or anti-Newtonian.[13] While English High-Church Newtonians such as Friend make any such assertions problematic, the High-Church camp was greatly concerned that reason could be used to undermine traditional sources of religious authority such as scripture.

These concerns were justified. The writings of philosophers such as Hobbes, Spinoza and Toland had seriously undermined the status of scripture in the late seventeenth century while Socinians like Stephen Nye claimed the doctrine of the Trinity was contrary to reason. The Trinitarian controversy that erupted in the 1690s consumed the interest of John Locke, an advocate of religious toleration who had Socinian sympathies.[14] Natural philosophy, embodying the pinnacle of reason, could become entangled in all these issues, especially since the thought of many natural philosophers such as Hobbes and Descartes led to materialism and Isaac Newton himself was a secret anti-Trinitarian. Given the rigidity of doctrine in High-Church thought, it is no coincidence that those anti-Newtonians such as Robert Greene, George Berkeley, Roger North and John Hutchinson identified by historians of science were High-Churchmen. As I will later show, Tories who did support Newton like Freind and the Scottish immigrants Keill and Arbuthnot adopted High-Church views on the dangers of the use of reason in religious matters, especially in their attacks on world making. What is therefore interesting, and needs particular explanation is why most Tory High-Church Newtonians in England initially came from Scotland, or, to put it another way, why those in Scotland from Episcopalian backgrounds were more receptive to the study of natural philosophy and natural theology.

In order to do this one must look at the very different political and religious contexts in Scotland. While in England politicians sought to preserve the existing ecclesiastical and political establishment, "the Revolution in Scotland amounted to a conscious effort to undo the Restoration settlement in church and state."[15] Episcopacy was abolished after James' flight to France and Presbyterianism re-established under William and Mary. This was of immense political significance.

Episcopacy or the rule of the Church of Scotland by bishops was seen as essential for the maintenance of hierarchy, order and kingly rule. It was through bishops that the king exercised influence. By contrast, Presbyterians by their rejection of bishops and the absolute monarchy represented a threat to social order. It is not surprising that Scotland was a hotbed of Jacobitism in the conservative Episcopalian North-east; in the words of Bruce Lenman it was "Episcopal spirituality" that "provided the steel in the Jacobite soul." [16] While Episcopalianism was popular among nobles and lairds, Presbyterianism had much support among the peasantry over a wide area of the southwest lowlands.[17] It is within this context that many of those who associated themselves with the Episcopalians developed a dislike for Presbyterianism, a populist religion linked with religious enthusiasm and political radicalism.

For militant Presbyterians matters of doctrine were of primary importance. Presbyterians were hard-line Calvinists who like High-Churchmen believed in the supremacy of the church over the state. From the time of Andrew Melville Presbyterianism has been characterised by a strong element of anti-Erastianism. With their church courts consisting of Kirk-session, presbytery, synod and General Assembly, militant Presbyterians sought to establish a theocracy in the seventeenth century. They believed their church had the right to punish heresy and sin independent of the state and the most radical Presbyterians or Covenanters were rigid in church discipline, even forbidding the celebrating of Christmas. Loyalty to religious covenants had supremacy over loyalty to the monarch. It was to such effect that Scottish Presbyterians took up arms against Charles I in the 1640s and the Cameronians, a radical Presbyterians sect, fought against Episcopal rule during the Restoration.[18]

Scottish Episcopalians developed a dislike for the dogmatic Calvinist theology of Presbyterianism and instead adopted latitude in matters of religious doctrine. In some cases their dislike of religious fanaticism led them to religious scepticism or, at the opposite extreme, religious mysticism. For those aristocrats who supported the re-establishment of Episcopacy in 1660, bishops were useful for the state to battle sectarian enthusiasm. In the words of Julia Buckroyd, the motivations for establishing Episcopacy in 1660 "can most nearly be expressed as a determination to be free of all direction and control by ecclesiastical persons of whatever kind. Since bishops were royal appointees, they could be used for other men's purposes but simultaneously denied any authority or power."[19] As we shall see later, Archibald Pitcairne and David Gregory exemplify those individuals whose dislike of religious enthusiasm and of the covenanting tradition led to an abhorrence of religious dogmatism.

On the other hand some Scottish Episcopalians turned to mysticism. From the Episcopalian stronghold of the north-east emerged a tradition that emphasised personal piety or the direct union of the soul with God, religious toleration and dismissed those overly formal aspects of religion which stressed matters of doctrine. From the Aberdeen doctors of the early seventeenth century through to later mystics such as Henry Scougall and John and James Garden, personal religion was more important than formal religion and a refuge from militant Presbyterianism.[20] Of the Gregory/Pitcairne group George Cheyne was most influenced by the mystical Episcopalian traditions of the northeast promoted by the Gardens and spiritual writers such as Madame Guyon and Madame Bourignon. In the 1730s and 1740s Cheyne would become involved with a group of English Tory mystics including William Law, John Byrom, John Freke and

Samuel Richardson.[21] In many ways Scottish Episcopalians could converge with English Latitudinarians in intellectual outlook, especially in their tolerant attitude toward doctrinal matters, but still be tied politically by their fervent anti-Presbyterianism to the English High-Church. Although liberal on some matters, supporters of Scottish Episcopalianism like Pitcairne, Gregory and the Gardens were hostile to Presbyterianism that they considered as politically and religiously subversive.

In general those who supported the Episcopalian cause in the late seventeenth and early eighteenth centuries were more receptive to the new mechanical philosophies that replaced Aristotelianism than their Presbyterian opponents, who were strong Calvinists and hostile to new learning. Scottish Presbyterians held negative views on the value of human learning much like English Puritans a half century earlier. Both Presbyterians and Puritans believed human reasoning was limited and that man could only achieve salvation – know he was a member of the elect – through the grace of God. Salvation was not the product of contemplative reason or good works. As John Morgan notes, in late seventeenth century England this "Puritan approach to human existence, which had decreed that the objective universe could provide no meaning, no longer satisfied increasingly significant proportions of the nation's intelligensia, which now searched instead for explanations capable of empirical verification." [22] In Scotland, however, such opinions persisted.

This gives Hugh Trevor-Roper's thesis that the Scottish Enlightenment "perhaps owed more to Scottish Jacobites, even to Scottish Catholics, than to Scottish Presbyterians: to the Jacobite physician Archibald Pitcairne, denounced as a deist or atheist and more at home in Leiden than in Edinburgh" some

legitimacy.[23] In two works Trevor-Roper attempted to refute the idea, promoted by the sociologist Robert Merton, that Calvinism or radical Protestantism was a precursor to the Enlightenment.[24] He argued that Calvinism, especially within its Scottish context, was fundamentalist and scholastic while those opposed to predestination, the Arminians and Socinians were receptive to the new philosophy, to the idea that humans could acquire religious knowledge through the use of reason and salvation through good works. This made Scottish Episcopalians, who did not adhere to the strict Calvinism of their enemies and were influenced by Arminian doctrines, more receptive to new learning.[25]

Trevor-Roper's argument is not without problems. There were many Scottish individuals who were neither Jacobites nor Episcopalians (or who cannot be classified into these two camps) who were interested in natural philosophy. Roger Emerson has noted how Whigs, Jacobites, Presbyterians and Episcopalians promoted natural philosophy in Scotland from the 1680s in his critique of Trevor-Roper's thesis.[26] Christine King has argued that the receptivity of Scottish universities to Cartesianism and Newtonianism in the late seventeenth century cannot be explained simply by the dominant politics of each institution.[27] While one can find persons[28] interested in natural philosophy that identified with all political and religious groups in the 1690s when the Gregory/ Pitcairne circle was forming, I will argue that many Scottish Presbyterians remained highly concerned about the heterodox uses of natural philosophy and of reason during this period. This made natural philosophers that supported the Episcopalians view the study of natural philosophy as an important counter to Presbyterian fanaticism and anti-intellectualism. For this reason natural philosophy could be

particularly attractive for those who opposed the post 1688 political and religious settlement in Scotland.

The Presbyterian Church after 1690 attempted to reassert its hegemony that had existed prior to the Restoration. It established the Confession of Faith and Catechisms as subordinate standards of theological orthodoxy and attempted to purge Scottish universities of Episcopalian sympathizers who would not submit to their new standards. The theocratic nature of much Scottish Presbyterianism after 1688 means that it cannot be seen as the cradle of the Scottish Enlightenment; it must be sought in the more moderate Erastian theology of Episcopalianism and the growing influence of England on Scottish intellectual life after the union.[29] As Nicholas Phillipson and John Christie have noted, explaining the Scottish Enlightenment also requires recognition of the institutional, ideological and intellectual discontinuities, focused upon the parliamentary union of 1707 and the reform of the University of Edinburgh, which occurred in the opening decades of the eighteenth century.[30] As a new more liberal theology flowed north from England, Presbyterians became more moderate and less Calvinist and theocratic. Indeed, the University of Edinburgh, which for twenty years was no better than a theological seminary, was transformed in the 1710s and 1720s when a new literati developed.[31] Previously those with royalist/ Jacobite and Episcopalian sympathies appear to have had an unusually large prominence in the Scottish natural philosophic community. This gives Trevor-Roper's thesis substantial merit within certain limits. In the case of Pitcairne and Gregory their enthusiasm for Newtonian natural philosophy was linked to their dislike of religious and political sectarianism.

Gregory, Pitcairne and their opposition to Presbyterianism

Archibald Pitcairne's (1652-1713) life is instructive for the early eighteenth century study of Scottish ideas. After a period of education on the continent, Pitcairne was made an original fellow of the Royal College of Physicians at Edinburgh in 1681 and was promoted professor of medicine at the University of Edinburgh four years later. In 1692 he was appointed professor of medicine at the University of Leyden, a post from which he resigned a year later.[32] At Leyden and thereafter Pitcairne campaigned in favour of a mathematical conception of physic. Influenced by Newton and such writers as Borelli and Bellini, Pitcairne believed medicine could be reduced to mathematical analysis and that illness was the product of impaired circulatory hydraulics. He opposed the use of explanatory mechanisms such as Cartesian subtle fluids and the ferments of chemical physicians as uncertain figments of the imagination.[33] Pitcairne attracted a lot of converts but also many enemies in his attempts to promote mathematical physic at the Royal College of Physicians of Edinburgh, attempts which led to the famous riot within the college. Clear divisions occurred upon the publication of George Hepburn's *Tarrugo unmasked* (1695), a book that defended Pitcairne against attacks on mathematical medicine found in Edward Eizat's *Apollo mathematicus*. Splits occurred in the College between Sir Thomas Burnet, Sir Robert Sibbald and supporters of Pitcairne like Archibald Stevenson. While the dispute did not exactly follow party lines (Sibbald was both a Jacobite and Episcopalian) most of Pitcairne's group were Jacobites while Burnet and Eizat were Whigs.[34] Pitcairne was to remain an active voice in the Scottish medical community until his death in 1713. His numerous medical essays were

published as *Dissertationes medicae* in Rotterdam (1701) and Edinburgh (1713) and were later translated into English.[35]

But Pitcairne was more than just a medical man. He was also a poet, playwright and accomplished Latinist. In the immediate aftermath of the re-establishment of Presbyterianism he wrote several satires on the Presbyterian dominated General Assembly. In the play *The assembly* and the poem *Babell: a satirical poem on the proceedings of the General Assembly in the year 1692*, Pitcairne portrayed Presbyterians as anti-intellectual religious fanatics for which he was attacked by some Presbyterians, with some justification, as a deist. In the above works, Pitcairne made his support for the Stuarts clear. He was a known Jacobite and had important connections with other prominent Jacobites such as John Erskine the Earl of Mar, leader of the 1715 rebellion.[36] Pitcairne was not afraid of controversy and his willingness to wear his party colours on his sleeve makes him useful for studying the political and religious conflicts of the times.

Although David Gregory (1659-1708) was considerably more hesitant to engage publicly in political and religious controversy, he shared similar intellectual and political commitments with Pitcairne. They were close friends.[37] Gregory was also a professor at the University of Edinburgh, elected to the mathematics chair in 1683, and was "taught from his babyhood loyalty to the Stuarts and a passionate adherence to the Episcopal form of church government and teaching, which he carried with him to the grave."[38] During the arrival of the Visitation Committee to the University of Edinburgh in 1690 to judge whether those holding university positions were suitable for the new religious and political regime, several of Gregory's colleagues, such as the principle Alexander Monro and the Professor of Divinity Dr. Strachan, were deposed. While the

committee accused Gregory of atheism, profaning the Sabbath, swearing and drinking, he was spared, although his refusal to submit to the requirements of the visiting commission made his situation precarious.[39] Fleeing to the warmer confines of Oxford, Gregory was made Savilian Professor of astronomy in 1692 largely on the recommendation of Newton.[40]

Gregory was a productive scholar and writer at Oxford. His publications included a work on optics, *Catoptricae et dioptricae sphericae elementa* (1695) and astronomy, *Astronomiae physicae et geometricae elementa* (1702).[41] In addition, he was active in the publication of Euclid's works and was planning an edition of Apollonius before his death. His numerous memoranda are also valuable sources for our knowledge of the Pitcairne/Gregory group, especially the memorandum deposited in the Christ Church Library at Oxford (MSS 346), which details his activities at the university between 1696 and 1708.[42] Also in the Gregory papers at Christ Church (MSS 163) is a *Review of the Covenant as it was entered into in the year 1638 in Scotland in a dialogue betwixt an Anti-Covenanter and an Old-Covenanter*, which was written either by Gregory or his father. This dialogue attacked Presbyterian fanaticism revealing clearly on which side David Gregory and his family stood.

Knowledge of what Pitcairne and Gregory opposed, militant Presbyterianism, is a lot easier to determine than their own religious views. The historian often has to rely on the biased declarations of others or on partial statements made in letters. Despite these problems the description by the Presbyterian Church historian Robert Wodrow of Pitcairne's character accurately summarizes Pitcairne's and probably Gregory's attitude toward religion.

> I am told he [Pitcairne] still spent three or four hours every morning in reading and writing, and some people talk that every day he did read a portion of

> Scripture, though, it seems, he made ill use of it. He was a professed Deist, and by many alleged to be an Atheist, though he has frequently professed his belief of a God, and said he could not deny a Providence. However, he was a great mocker at religion, and ridiculer of it.[43]

The contradictions that Wodrow constructs in this paragraph are significant: Pitcairne reads scripture yet is a deist; Pitcairne is an atheist yet he professes a belief in God. This paragraph reveals that Pitcairne was one of many intellectuals who, like Locke and Newton, increasingly subjected scripture and doctrine to the test of reason and historical criticism in the early eighteenth century, an approach to the bible that Wodrow believed led to a rejection of revelation. Pitcairne and Gregory were against religious dogmatism and they took a more critical attitude toward scripture by elevating reason at the expense of revelation and mystery. Whether Gregory and Pitcairne were true deists, rejecting all revelation, is harder to determine.

Presbyterians like Wodrow had good reason for viewing Pitcairne as a mocker of religion and as a deist. Pitcairne was somewhat insolent and his quick wit often led him into trouble, resulting in accusations of deism and even atheism that Pitcairne and his friends denied. For example, the Presbyterian commission that visited Edinburgh in 1690 accused the principle Alexander Monro of passively standing by at a graduation while Pitcairne was purported to have ridiculed the Confession of Faith and denied the existence of God. Monro replied that Pitcairne had not attacked religion but had only sought to establish the fundamentals of religion in their true light.[44] In July 1712, Pitcairne instituted a legal process against James Webster for accusing him of supporting deism at a public dinner, given by the Magistrates of Edinburgh. This dispute had arisen at a book auction where "a Bible was put up, for which there were no bidders. Upon one of the company, at dinner, regretting the depraved taste of the times, Dr.

Pitcairne observed, 'It is no wonder it stuck in their hands, for *verbum Dei manet in aeternum*'." [45] Webster, a Presbyterian minister of Tolbooth Church at Edinburgh, who later took a leading part in the prosecution of John Simson for Socinian and Arminian errors, did not let such a witty comment pass in silence. Pitcairne's statement must have confirmed his suspicions and those of others of the doctor's low value for scripture. The legal battle between both sides was conducted with much zeal. Apparently the charge of deism was still scandalous enough in the early eighteenth century to provoke a denial by Pitcairne.

Attacks on Pitcairne were not confined to his behaviour. As an exponent of the new Newtonian mathematical medicine, he contrasted the certain status of geometrical demonstrations with less certain knowledge based on historical testimony. For many such as Edward Eizat, an opponent of Newtonian medicine and a Scottish Whig, an intimate association existed between mathematics and freethinking. In his *Discourse on certainty*, appended to his *Apollo mathematicus*, Eizat attacked Pitcairne for asserting in his *Solutio problematis de historicis; seu de inventoribus dissertatio* that "nothing is infallibly certain, but a Demonstration; and that all other certainty, even that which depends on the faith of History, is nothing but Probability and meer Conjecture; and consequently all the Infallible or Indubitable Certainty we can expect from any History, tho never so well attested, is, That it is infallibly uncertain."[46] Thomas Halyburton, a Presbyterian divine, also criticised the claims of mathematicians like Pitcairne. In a work attacking deism he stated that geometrical definitions "might be alleged upon no inconsiderable grounds trifling, nonsensical and plainly ridiculous. Its demands on postulates, impractible, its axioms or self-evident propositions, controvertible, and by themselves they are controverted."[47] In contrast historical knowledge

derived from the Bible was certain. Halyburton was appointed professor of divinity at St. Andrews in 1710. His inaugural lecture attacked an anonymous pamphlet written by Pitcairne, *Epistola Archimedes ad regem Gelonem,* as a theistical or deistical pamphlet. As with Pitcairne's *Solutio problematis de historicis*, this essay elevated geometrical knowledge above that based on human testimony.[48] Individuals like Eizat and Halyburton were not unjustified in seeing a relationship between mathematics and freethinking. Other mathematicians such as John Craige pointed out the weakness of historical testimony and how the credibility of scripture had decreased over time.[49]

Like English Latitudinarians, Pitcairne saw a religion based on reason as a refuge from religious fanaticism and popery. As a counter to fanaticism, he believed natural theology could provide proofs for the existence of God and His providence. Pitcairne's correspondence reveals he intended to write a demonstration of the Christian religion in the 1690s, a *Religio mathematici* or *Euclidis*.[50] He wrote to Dr Gray that Gregory had been asked "to procure me a scheme of Mr. Newton's divine thoughts, (I hope yee'l not laugh) that I may write a demonstration for our religion: but this will be a tale of two drinks. I am confident tho that better things may be said to that purpose than hitherto has been said."[51] A decade later on the eve of the publication of the famous Latin edition of Newton's *Optice*, Pitcairne exhorted Gregory: "For God's Sake keep Sir Isaac Newton at work, that wee may have the chymical business, his thoughts about God, more of vacuum which he promis'd to me at Cambridge, that of hardness or greatest attraction, (the matter of atomes) and elasticity if he pleases."[52] Pitcairne would have agreed with the statement of Roger Cotes in the preface to the second edition of the *Principia* that "Newton's excellent treatise will stand as a mighty

fortress against the attacks of the atheists."[53] What led Presbyterians to suspect Pitcairne of atheism was his critical or mocking attitude to scripture, miracles, and divine inspiration.

A similar picture emerges of David Gregory. There is a famous story about him: "a Scot, a stranger came severall times to a Coffee House wch Dr. Halley used, and often asked the man after him. But the Dr. not happening to come, the man enquired after his pressing business. Why (says he) I would fain see the man that has less religion than Dr. Gregory."[54] But in the attacks of Scottish Presbyterians Gregory's religious views are most visible. Like Pitcairne, Gregory denied charges of atheism asserting that reason and natural philosophy served as an excellent foundation to prove the existence of God. Responding to the Visitation Committee's charges of irreligion, Gregory replied:

> it is impossible for a reasonable thinking man to be ane atheist so that to accuse me to be somewhat which it is impossible for me to be, and since the visible things of God doe show the invisible God, I must tell you my Lords that I know so much of the vastness, order and harmony in the great parts of the universe, such a symmetry and convenience in the laws by which they act one upon another that I cannot but have the due notion and impressions of a God and his infinite attributes of power and providence which becomes a philosopher, a Christian.[55]

As with Pitcairne, Gregory met accusations of atheism with strong assertions to the contrary.

However, reason could also be used to undermine traditional sources of religious authority such as scripture. This point was made by Halyburton in his *Natural religion insufficient, and revealed necessary to man's happiness in his present state* (1714). In this work Halyburton criticised the Socinian Stephen Nye's *Discourse concerning natural and revealed religion* (1696). In the course of his critique he provided a quotation from Nye's work that revealed Gregory's possible heterodox tendencies.

> I could……prove I think by undeniable, unavoidable instances what Mr. Gregory of Oxford says in his preface to some critical notes on the scriptures that he published, there is no author whatsoever, saith this learned critick, that has suffered so much by the hand of time, as the Bible has.[56]

So far I have been unable to locate any work that matches the above description. If such a book had been published it was likely authored anonymously. It is also possible that these critical notes circulated privately in manuscript among a circle of like-minded individuals. Whatever the case, there is good evidence to suggest that the Gregory referred to in Nye's quote is David Gregory Savilian professor at Oxford.

The publication of the above critical notes would reflect the intellectual trends of the post revolution decades. The 1690s witnessed a great explosion of anti-Trinitarian thought. During this period Socinians and Arians like Nye, Thomas Firmin and Matthew Tindal questioned the doctrine of the Trinity. Religious doctrine derived from scripture was increasingly subject to rational analysis and criticism. Both Anglican divines and anti-Trinitarians believed reason could be reconciled with scripture, but for the latter group key Trinitarian texts rested "on faulty copies, imperfect translations, and purposeful tampering with manuscripts by Trinitarian scribes."[57] This was the opinion of Newton. Commenting to John Locke on 1 John 5:7, a passage frequently used to support the Trinity, Newton declared that

> Tis the temper of the hot and superstitious part of mankind in matters of religion ever to be fond of mysteries, and for that reason to like best what they understand least. Such men may use the Apostle John as they please, but I have that honour for him as to believe he wrote good sense, and therefore take that sense to be his wch is the best.[58]

While reluctant to publish his views, Newton himself rejected the Trinity believing that the true religion and scripture had become debased by false idols. Through his studies of ancient history he became convinced that the true religion,

which was monotheistic, prevailed at the time of Noah. This religion had been communicated to the Egyptians who had corrupted it with the worship of false Gods. The process of religious purification was presently continuing and the goal of Newton was to return the Christian Church back to the primitive monotheism of the past.[59] Locke also had anti-Trinitarian sympathies. His *Reasonableness of Christianity* (1695) rejected original sin (a stance common among Socinians) while remaining agnostic over the support texts such as 1 John 5:7 gave to the Trinity.[60]

Intellectuals during this period were not only using their private judgement to criticise orthodox doctrine, some were also attacking the idea that scripture was in harmony with reason. As Gerard Reedy has noted a "rational defence of scripture is perilous business. A fine line exists, at times, between rationalist scriptural theology and a rationalist undermining of scriptural authority."[61] According to philosophers such as Herbert of Cherbury, Hobbes, Spinoza, John Toland and Charles Blount, revelation was contrary to reason and used by Anglican clergy to inculcate obedience to the established church, something that freethinkers, in anti-clerical diatribes against the Anglican hierarchy – attacks that associated its leaders with Catholicism – labelled as priestcraft. Along with Arianism and Socianism, deism emerged hand in hand with critiques of priestly authority. John Toland's *Christianity not mysterious* (1696), which sought to free religion from the corruptive influences of priestcraft, is illustrative of this.[62] The early English Enlightenment was in full bloom. Gregory and Pitcairne were certainly influenced by these trends.

Gregory was in contact with Newton and possibly with Toland in the early 1690s prior to the publication of Nye's *Discourse*. He had read Newton's tract on

ancient religion *Theologiae gentilis origines philosophicae* in 1694 and had been exposed to his views on primitive monotheism. In his memoranda for May of that year Gregory noted that Newton "has composed a tract on the origin of nations. Religion is the same at all times, but religion which they received pure from Noah and the first men, the nations debased by their own inventions. Moses began a reformation but retained the indifferent elements of the Egyptians."[63] It is also likely that Gregory had met Toland at Oxford in May 1694. Toland, who had studied at Edinburgh in 1690, had his M.A. diploma signed by Gregory.[64] After his stay at Edinburgh he left for Leyden where Pitcairne was teaching. Gregory had also been in Holland in 1693. In May 1694 Toland was at Oxford where another notorious freethinker Matthew Tindal also resided. All these connections suggest that Gregory is a possible candidate for authorship of the preface referred to in Nye's work.[65]

Pitcairne's and Gregory's sceptical attitude toward scriptural authority was related to their fervent dislike of Presbyterians, people who they perceived as religious fanatics foolishly clinging to dogmatic biblical beliefs and rejecting reason and good judgement. The Christ Church manuscript entitled *A review of the covenant as it was entered into in the year 1638 in Scotland in a dialogue betwixt an anti-Covenanter and an old-Covenantor* illustrates this.[66] The title page states it was written by David Gregory of Kinardy in 1705 at Aberdeen. It is possible that this work was written by Gregory the astronomer and not by his father who was also named David. Gregory's memorandum reveals that he was in Aberdeen in 1705;[67] during this period of his life he was very interested in Scottish history.[68] Regardless of the question of authorship the work is an important indicator of the Gregory family's attitude toward Presbyterianism. In

the *Review of the Covenant* Gregory, whose voice is that of anti-Covenanter, attacked Presbyterianism for being theocratic. Militant Presbyterians were guilty of mimicking the beliefs and practises of the Pope and Jesuits by not allowing the King any authority over spiritual matters. Reflecting upon the persecution of Episcopalians in Scotland, Gregory declared that the Covenanters did

> set up to ape the very court of Rome it self: for tho they seemed to abominate the Romish Hierarchy in a single person….. yet they made no scruple to sett up an Hierocratia, by which, partly by the Generall Assemblys, but especially by their commissions; they Lorded over the people of the whole Kingdom; exalting themselves above all that was called God within their sphear.[69]

For Gregory Presbyterians were inherently rebellious for they put loyalty to religious covenants above obedience to monarchs.

Pitcairne had similar criticisms of the Presbyterians. In his two satires of the Presbyterian General Assembly, the play *The assembly* and the poem *Babell*, Presbyterians are portrayed as dogmatic biblical literalists who suffer from bouts of false religious inspiration and are enemies of the monarchy.[70] When the two main characters of *The assembly*, Frank and Will, see a group of Presbyterian ministers walking in the street Will exclaims: "Gad, that's a Parcel of Presbyterian Ministers, I Faith Theirs may be called the Foolishness, of Preaching in a literal sense; both in their Prayers and Sermons." Will adds: "they [hate] confinement to Sense and Reason, but freely have such confused Notions as the spirit of God dictates to them."[71] At the end of the play, when King William decides to disband the General Assembly for their persecution of Episcopalians, the members urge rebellion even against their Whig ally. The Presbyterian 'Turbulent' – his name reflecting the disturbed and disordered state of the Presbyterian mind – exclaims: "Let us break their Bonds, and cut their

Cords ascunder: That's the Oath of Alledgeance and Assurance. Let us stir up our Brethren in the West to shake that Tyrant's Throne."[72]

But it is Pitcairne's association of Presbyterianism with a form of anti-intellectualism that is most interesting. Pitcairne clearly saw Presbyterians as scholastics opposed to the new mathematical medicine he was promoting. For example, the Presbyterian characters in *The assembly* were quick to charge mathematicians with gross errors and infidelity. 'Visioner', whose role in the play is that of a fanatic Presbyterian news-monger, states "shew me a Mathematician among 100, that cares for the Confession of Faith – I am told that the First Prob in Euclid does prove, That the world is eternal; and the Second, That there is not a God: Besides, one must have a compact with the Devil ere he can understand them."[73] Pitcairne's Jacobite newsman 'Novel' is not impressed. When Visioner complains of the lack of respect that students are giving their new Presbyterian university teachers, Novel responds that this should occasion no surprise for there "are few Lads in the College who have not more Latin than their Primar; and more Mathematicks and Philosophy than their Regents; who know nothing but Metaphysical Jarrings."[74] In contrast to the negative reception of mathematics and the new mechanical philosophies among Presbyterians, Jacobites and Episcopalians were enthusiasts for the new learning. Indeed, a member of the Presbyterian General Assembly 'Mr. Salathiel' stated that its "the Lord's Doings that hath purged the Fountains and Seminaries, they were all over-grown with Cartle's [ie Descartes'] Mathematicks and humane Reasoning; yea some of them were so blasphemous, as to maintain that the K was supream and unaccountable." [75] While opposed to Cartesian theories, Pitcairne used all

resources at his disposal to portray Presbyterians as adversaries to new intellectual trends in natural philosophy.

Opponents of Pitcairne and Gregory like the Presbyterians Halyburton and Wodrow worried that the rising belief in the powers of human reason and philosophy to understand the mysteries of religion led inevitably to religious heterodoxy, and feared liberal bishops in England and their Episcopal friends in Scotland had fallen prey to these notions. Both Wodrow and Halyburton expressed concern with the growth of Arminian and Socianian doctrines in England and Scotland, especially after the Union of 1707. Halyburton blamed Arminian theology for the rise of deism and infidelity in his age. Arminians had foolishly reduced all religion to meer morality: "they expressly deny any Thing to be fundamental which has been controverted, or afterwards may be so."[76] Wodrow agreed "Arminianism paves the way for Arianism and Socinianism, and that must lead the person to Deism, and rejecting of Revelation."[77] Scottish Episcopalians, who rejected the strict Calvinism of their opponents and expressed a more tolerant attitude on doctrinal matters, were influenced by Arminian doctrines. In his satires of Presbyterians Pitcairne was always quick to point out how the General Assembly accused Episcopalians of Arminianism and Socinianism.[78] Writing after the union of the two kingdoms, Halyburton worried that the "Times are infectious, and Deism is the Contagion that spreads."[79] His fears were justified. The aftermath of the Union would witness a gradual liberalisation of the Presbyterian Kirk.

Natural philosophers were part of the problem. Wodrow's correspondence expresses considerable concern about the spread of anti-Trinitarian ideas among natural philosophers in the early eighteenth century. He was aware of the

theological controversies over the Trinity that Newton's disciples William Whiston and Samuel Clarke had sparked. Despairing about the growth of Arianism he wrote to the Reverend George Chambers: "I have been told that the late Bishop of Ely, whose chaplains Whiston and Clarke were, and Sir Isaac Newton, and others of a greater figure, were of these sentiments, and had corrupted multitudes."[80] A year before Newton's death, commenting on John Simson's unorthodox views on the Trinity, Wodrow noted the congruence between Clarke's notions of God's nature and Newton's, likely indicating a familiarity with Clarke's anti-Trinitarianism and its relation to Newtonian metaphysics of space and time.[81] Despite Presbyterian hegemony after 1688 such heterodox ideas were contaminating Scotland. Lord Grange wrote to Wodrow that "all the English Bishops, excepting one or two, whose names I have forgot, are of Dr. Clarke's sentiments….. may the Lord keep them [anti-Trinitarian doctrines] out of our Church."[82] While Newton, Clarke and Whiston differed politically from Pitcairne and Gregory, they shared with the two Scots a commitment to a religion firmly grounded on reason. Pitcairne's *Epistola Archimedis ad regem Gelonem* suggests that even he too questioned the doctrine of the Trinity.[83]

Pitcairne's and Gregory's interest in natural philosophy was connected with their opposition to religious fanaticism. They had a common image of the Scottish Presbyterian as a dogmatic, puritanical and rebellious individual who foolishly clung to the old scholastic philosophy. In response they developed a more sceptical attitude to formal religious doctrine that led to a more critical stance toward scripture. While Pitcairne's depictions of the Presbyterian in his plays and poems can be interpreted as caricatures, his portrayals of them should

not be judged as mere rhetorical ploys in debates between political and religious opponents. Despite the difficulties of distinguishing fictional and polemical intent from historical fact, I have argued that Pitcairne's attacks had a historical foundation that gave his satires added force. Certainly Pitcairne was not alone in using verse to promote the Jacobite and nationalist cause in Scotland.[84] While Pitcairne's and Gregory's religious views should not be seen as representative of all Scottish Episcopalians, the Scottish Episcopal Church was much less rigid over matters of doctrine than their Presbyterian enemies. This meant that for those who were opposed to the post 1688 Presbyterian establishment, reason and natural philosophy could be a refuge from religious fanaticism. Mathematical natural philosophy was useful in serving this function.

Mathematics, certainty and order

Newton's *Principia*, modelled on Euclid, captivated the minds of Pitcairne and Gregory. When both men became committed Newtonians in the 1690s, Newtonianism possessed a different connotation from the experimental Newtonianism that emerged after 1704. This later form of Newtonianism received its inspiration from the queries in several editions of Newton's *Opticks* beginning with the first, 1704 edition. Following Newton's speculations on attractive powers and ethers, experimental natural philosophers in the early eighteenth century sought to isolate and provide evidence for these phenomena through the use of experimental apparatus such as the electrical machine.[85] But from 1687 to 1704, when the Gregory/ Pitcairne circle was forming, Newtonianism meant something different. The highly mathematical and technical

Principia with its laws that only the most skilled mathematicians could understand were the primary source for Newton's thought. In the *Principia* Newton restricted discourse to mathematical constructs which were analogues of physical systems.[86] He did not seek to provide explanations or hypotheses for phenomena such as gravity but only the mathematical laws by which gravity operated. Pitcairne and Gregory were enthusiasts for Newton because he promoted a mathematical natural philosophy that offered a more certain picture for how the universe operated than all others.

Certainty was important for Pitcairne and Gregory in a world that seemed potentially chaotic. Both disliked the notion of factions in philosophy and politics that seemed a threat to peace and order. Politically Scottish Jacobites and Episcopalians held similar views on the necessity of hierarchy, order and subjection to authority as their English Tory High-Church allies.[87] Criticising Presbyterians who believed they were inspired by the illuminations of the spirit, the Scottish Episcopalian divine Robert Leighton emphasised the importance of the guidance of bishops in spiritual matters

> Seeing that such persons as these are also God's deputies in a more public authoritative way than any private man's conscience, why are we not to hear them and to presume that their consciences, as the voice of God, is to be followed and not disobeyed.[88]

For Tories and Jacobites in both kingdoms factions were a threat to the state and to duly constituted authority; they represented a private interest as opposed to a public interest, a disease in the body politic. The public interest was represented in the person of the monarch. As reflected in the very different political works of the royalists Robert Filmer and Thomas Hobbes, disorder and anarchy were caused by the formation of faction.[89] In the early eighteenth century, Tories such as Bolingbroke, Swift and Pope attacked what they conceived to be the growth of

faction, the moneyed and dissenting interest.[90] When Pitcairne and Gregory were introduced to Newtonian natural philosophy in the 1690s the fear of faction, of the Covenanters, was uppermost in the minds of those who identified with the Scottish Episcopalian interest. As defenders of the public interest, supporters of absolute monarchy and Episcopalian Church government saw themselves as standing above party faction.

Of all the branches of learning mathematics has traditionally been viewed as the most useful in gaining assent and authority within the community of natural philosophers. As a mathematical demonstration garnered unquestioned assent so too did a king rule through his unquestioned authority. As Steven Shapin and Simon Schaffer have noted in the case of Thomas Hobbes, the *Leviathan* offered philosophical methods to secure assent that were based on geometry.[91] Newton's *Principia*, written in the language of ancient Greek geometry, could also serve as such a model. By mathematically demonstrating the laws by which celestial and terrestrial bodies moved and avoiding hypothetical discussions of the causes of motion, Newton's work was seen by Pitcairne and Gregory to possess a degree of certainty that other non-mathematical works on natural philosophy lacked. The language of the *Principia* could thus serve as a discourse of order.[92] Mathematical natural philosophy bred authority and assent while non-mathematical natural philosophies bred dissent and faction.[93]

Unlike the uncertain physical speculations of Cartesians and Paracelsian chemists, Pitcairne and Gregory praised the certainty of geometrical demonstrations, and they made a strong parallel between uncertainty in natural philosophy and enthusiasm in religion. Descartes' natural philosophy provided a useful example of philosophical enthusiasm. This philosopher's attempt to

ground a universe on rational first principles appeared highly subjective and vain, and his belief that knowledge of God was innate implied that humans had some inner experience of God like the inner light of the Quaker. As Michael Heyd has noted "Cartesianism was seen by its critics as a manifestation of enthusiasm. That label was ascribed to Descartes with all its seventeenth century connotations of pretension to direct divine inspiration, subversion of social order, irrational epistemology and psychological madness."[94] In the minds of Pitcairne and Gregory there was an intimate association between the vulgar romances of Cartesian causal explanations, chemical physicians who based their physic on fictitious principles, medical empirics and Presbyterian fanaticism. Pitcairne's *Epistola Archimedes ad regem Gelonem* illustrates this. In the *Epistola* Pitcairne criticised ancient religious sects like the Etruscans whose laws and rites were inspired by the god Tages – laws and rites that were the product of false inspiration and human imposture.[95] These rules were contrasted with moral laws known through our reason and that were certain like geometrical demonstrations. Those who did not use geometry in their natural philosophy and promoted fanciful vain hypotheses mimicked the beliefs and behaviour of religious fanatics, both ancient and modern.

Evidence for Pitcairne's and Gregory's views can be found in their inaugural lectures at Leyden and Oxford respectively. The timing of these two lectures is significant. Both were given in 1692 when Scottish Presbyterians were reasserting their authority lost since the Restoration. Pitcairne's *Oratio qua ostenditur medicinam ab omni philosophorum secta esse liberam* and Gregory's *Oratio inauguralis a Davide Gregorio M.D: astronomiae professore saviliano* praised the use of geometrical methods in medicine and astronomy.[96]

Pitcairne's inaugural lecture in particular promoted the application of geometry to medicine. Inspired by Archimedes and the medical men Giovanni Borelli and Laurentio Bellini, he attempted to produce a deductive theory of medicine in the same manner as Newton had treated the heavens. He rejected the physiological theories of the Cartesians relating to secretion and the ferments of the chemical physicians; instead he encouraged his students to study the powers and relations of the human body and the body's operation as a hydraulic machine.[97] In the *Oratio*, Pitcairne argued against the search for physical causes in medicine stating "such Enquiries after Physical Causes as are generally proposed by the Philosophers, are entirely useless and unnecessary to Physicians." Like a good Newtonian of the 1690s he declared that "our Knowledge of Things is confined to the Relations they bear to one another, the Laws and their Properties of Powers."[98] Pitcairne was sceptical of the existence of Cartesian subtle fluids and was even hesitant to enter into discussions about the true nature of Newtonian attractive powers. In this respect Pitcairne was following Newton's approach to the problem of attraction in the *Principia* (1687), whereby speculations about the nature of forces were eschewed in favour of mathematical demonstrations. Such hypotheses were mere philosophical speculations in contrast to the certainties of mathematical demonstrations.

Gregory's inaugural lecture also praised mathematical natural philosophy based on geometry and attacked the fictions of the Cartesians. He applauded past astronomers such as Kepler for their application of geometry to astronomy. But Newton received the greatest praise: at "length there dawned that most desirable day in which to the immortal glory of this age and people the physical forces of natural bodies were assimilated to a genuine pattern, that is to geometry."[99]

Descartes is criticised for abandoning the geometrical methods of Kepler and attempting to "investigate the causes of things logically, or rather, sophistically." Gregory complained that Descartes was "intoxicated by easier and less composite laws, and, not applying his geometric ability in the slightest, fell into errors from which we were at length liberated by the aid of geometers."[100] Descartes system was nothing more than a fable or romance lacking the certainties of Newton's *Principia*.

In both lectures Pitcairne and Gregory emphasised the tendency of non-mathematical sciences to breed dissent and faction. The search for natural causes only led to disagreement among various natural philosophers. Indeed, Pitcairne declared "these are Points which the Heads and Patrons of Sects have wrangled about from the Beginning of the World to our Days, and all to no Purpose."[101] He asserted that in ancient times medical men were all of one sect because they based their medicine on the same principles as astronomers who avoided such uncertain "Opinions as are grateful to the Vulgar, or generally received by Orators" and who "Never in the Explication of the Motion of the Planets, call in the Assistance of a Romantic Hypothesis concerning the Structure of the World."[102] Non-mathematical natural philosophy led to uncertainty. Its patrons were the philosophical vulgar, men unlearned in geometry and Latin who could not discourse with the elite community of mathematical natural philosophers. In a similar vein Gregory stated that

> now no one can be received into astronomical citizenship who is not a visiting citizen in the most abstruse geometry and has not arisen from the *patrician*, that is the geometrical, family of philosophers. In the past many very base Remus' leapt over the walls of the astronomical city, but now the geometers have so fortified it with a ditch and a rampart that the portals of the sun receive those whom impartial Appollonius has loved and whom Kepler, Wren, Wallis and Newton have borne to the aetherial regions, and accordingly the

> profane, that is ungeometrical men, are exiled and depart from the grove and wander away over the whole heaven.[103]

Here the geometers are portrayed as the patricians; those who lack geometry are the plebeians. The patricians are allied with Romulus while the base plebeians are represented in the figure of Remus, the brother of Romulus, who according to Roman legend challenged the authority of the Roman king and was killed while leaping over the wall. The story also has parallels with that of Archimedes' defence of Syracuse. Archimedes, whom Pitcairne and Gregory greatly admired, had constructed ballistic machines to ward off the invading Romans from Syracuse's walls.[104] Gregory re-constitutes the community of learning as a patriciate, in particular a geometrical patriciate, resident in a heavenly city, from which the profane are excluded – an image of order at once political, religious and intellectual, and based fundamentally on hierarchy and exclusion.[105] As there was natural hierarchy in society so too was there hierarchy in natural philosophy with the mathematicians at the top battling the sectarian philosophy of their opponents. Gregory's experience at Edinburgh could not have been far from his mind when he wrote these words.

Scottish Newtonians and the politics of medicine

The political uses of mathematics are further illustrated in the medical disputes between Pitcairne and his Scottish opponents in the 1690s. At Leyden Pitcairne made several converts to Newtonian medicine. These included George Hepburn, William Cockburn and George Cheyne, all from Scottish Episcopalian backgrounds.[106] Pitcairne also had a profound influence on the satirist John Arbuthnot, son of a deprived Episcopalian clergyman and best known for his

associations with Swift and Pope.[107] All of the above defended Pitcairne from the attacks of his medical opponents such as the Scottish Whigs Andrew Brown and Edward Eizat. Instead of Pitcairne's mathematical physic, Brown and Eizat promoted a bedside medicine based on experience, combining an empirical approach with an enthusiasm for Cartesian mechanism.[108] Through studying the disputes between supporters of Pitcairne and the doctor's enemies one can understand how mathematical medicine was seen as an effective counter to medical empiricism and Cartesian physiology. The political views of members in the dispute were intimately related to their methodology.

In his *A vindicatory schedule concerning the new cure of fevers* (1691) Andrew Brown attacked traditional rational medicine based on theory advocating instead a purely experimental physic grounded on experience. Brown presented himself as a reformer. Politically he was a Whig and he linked his Whig politics to his programme for medical reform. In his treatise, Brown followed his mentor Thomas Sydenham in the promotion of an empirically based medicine grounded on bedside clinical experience. Sydenham advocated the writing of medical histories, the knowledge of which could be useful in affecting medical cures. He was an apologist for the Commonwealth and like other radicals of the Civil War period a promoter of political, religious and intellectual reform.[109] In the *Vindicatory schedule* Brown followed Sydenham in urging physicians to make detailed notes of diseases and of their history in order to understand the relationship between symptoms, causes and disease. It was only through such an exact historiography that medicine could be improved. He also warned physicians of the danger of uncritical adherence to theory. Theories were valuable only insofar as they were based on practise: "It's therefore only Solid

and Sound Practise that must yield a true theory, and such will altogether quadrate with practise, and be farther useful thereto, as is plain in several Mechanick Arts."[110] According to Brown it was the mechanic who gave laws to the philosopher.[111]

Four years later when Pitcairne published a tract attacking Brown's theory of fevers titled *Dissertatio de curatione febrium*, Edward Eizat countered by publishing his *Apollo mathematicus* attacking Pitcairne's mathematical physic. For Eizat mathematical demonstrations had no part in medicine, since medicine was a conjectural science and a practical art.

> Did ever any thing more wild or extravagant enter into the Mind of Man, than to imagine that this speculative Science [mathematics], that goes all by Demonstration, shall be of use in a practical Art founded on Experience? In which there are no infallible Conclusions, either as to the Event or Cure of Diseases, but only high Probabilities and rational Conjectures, as in other practical Arts, such as War, Agriculture, Politicks.[112]

While placing much more emphasis on medical hypotheses grounded on experience than Brown, Eizat shared with him the notion of medicine as an art grounded on accumulative wisdom. As such it was a conjectural study and not reducible to mathematical demonstrations, single theories or fixed laws.

Both Brown and Eizat made a connection between strong claims for mathematical theory and authoritarian politics. In his *Vindicatory schedule* Brown linked the tyranny of medical theory with the tyranny of the monarch; both the power of a monarch and unrestrained medical authority were based on vain theories and opinions.

> For opinion being the Monarch, bearing greatest sway in the minds of Men, has his Dominion upheld for most part by appearances, mistakes and errors, these being the most Plausible wares and Passable Coyne in that state.....And this Empire likewise extending it self over the Province of Medicine, thorow the misrepresentations brought therefrom to that court, in depressing true merit to exalt the umbrage thereof, exercises most of its Tyranny and arbitrary government there.[113]

Criticising Pitcairne's claim that the pores of glands used in secretion were round, Eizat also made an association between mathematical theory and authority linking mathematics to the Church of Rome in a subtle jibe at Pitcairne's Jacobite politics.

> Now this Paralogism, or rather Deliration, is not only believed by the Doctor [Pitcairne] and his Admirers to be a Mathematical Demonstration, but (as he says himself) is approven for such, by two of the most famous Mathematicians in Europe. From which I observe, that most famous Mathematicians may fall into foul Mistakes; and that implicate Faith is a necessity in the School of Archimedes, as in the Church of Rome. For to believe a Dream to be a Demonstration in contradiction to our Reason, and Bread to be Flesh, contrary to our Senses, is equally absurd.[114]

The Pope had no greater claim to infallibility than Pitcairne's mathematical demonstrations. The certainty and authority that geometrical demonstrations garnered had the potential to justify the authority of an absolute monarch.

In contrast to Brown and Eizat, disciples of Pitcairne such as George Hepburn, George Cheyne, William Cockburn and John Arbuthnot believed that Newtonian mathematical theory was essential to the physician; it provided the theoretical structure from which the sensory data of experience could be organized. During and after the famous riot of the College of Physicians sparked by Hepburn's attack on Eizat in *Tarrugo unmasked* (1695), these men promoted the necessity of mathematical theory. The cases of Cheyne and Arbuthnot are particularly illustrative of the connections between mathematics, medicine and politics. Inspired by Pitcairne and Newton, Cheyne advocated the publication of a *Principia medicinae theoretica mathematica* in 1702.[115] For him mathematical physic was superior to that of mere empirics and mechanics just as patricians stood above plebeians. He stated the debate between Pitcairne and his opponents as follows:

> The true state of the debate is, Whether…..a Mathematician who knows the Reason of what he does, and consequently can accomodat his art to all particular emergencies, wou'd not make a better Sailor, than a meer Tar, who works like a Machine as he is acted by Powers unknown to him; and who, if he be put out of his Road by any unforeseen accident, knows not what to do.[116]

In contrast to Brown who believed it was the mechanic that gave laws to the philosopher, Cheyne saw the relationship as reversed. The mathematician

> who besides the Practise, understands the Theory, will find Expedients for all Emergencies; and show his Skill most where the Difficulty is greatest. And this is one principal Difference, as to the Practise of all Kinds, betwixt a meer Mechanick and a true Philosopher, who can both think and act.[117]

Mathematical theory was to be supplemented by observations that would lead to a true mechanics of bodily motions without resorting to the fictitious subtle fluids of the Cartesians or chemical physicians. While Pitcairne and his followers shared with Descartes a belief in the importance of mathematics in natural philosophy, they differed from him regarding the value of hypotheses, based on metaphysical first principles or clear and distinct ideas, in physic. For them Cartesian explanatory mechanisms were philosophical romances, dreams of the religious enthusiast, with little experimental foundation.

While Arbuthnot did not receive medical instruction from Pitcairne at Leyden like Hepburn, Cheyne or Cockburn, Pitcairne influenced him also. In a recent article David Shuttleton has identified the anonymous pamphlet, *A modest examination of a late pamphlet entituled Apollo mathematicus*, as being written by Arbuthnot.[118] In this attack on Eizat, Arbuthnot challenged the former's opinion that mathematics played no part in medicine. As well as physic, Arbuthnot asserted that many of the practical or mechanical arts such as navigation, glass-grinding and clock-making depended for their improvement on

mathematical theory. This satirical work cleverly linked Eizat and his followers to the plebeian mob and to Whiggery. Indeed, Arbuthnot declared

> By the small Tast I have given you of the Author's Writings, I hope you will agree with me in one thing, that if, as he says, p 26 Nonsense be either a sign, or effect of Liberty, Apollo Mathematicus is a lasting monument of the mild Government of K. William and Mary.[119]

As David Gregory thought geometers were member of the elite, so too did Pitcairne and his followers like Cheyne and Arbuthnot think they were superior to those Whig physicians such as Brown and Eizat that were ignorant empirics and quacks.

However, Brown and Eizat were not only ridiculed for their empiricism and lack of mathematics; they were also criticised for their employment of elements of Cartesian physiology. While Brown in particular urged physicians to be cautious about physical theory, both he and Eizat made use of Cartesian explanatory mechanisms such as sieve-like glands to explain secretion. According to Descartes, the pores of glands had openings specifically shaped for the type of corpuscles that moved through them. For example, cube shaped corpuscles would be secreted through glands with cubed shaped orifices. In his *Dissertatio de motu sanguinis per vasa minima*, Pitcairne attacked this Cartesian explanation of secretion.[120] Using mathematics Pitcairne showed that Descartes' theory was improbable since a cube shaped particle would have to approach the cube orifice at precisely the right angle in order to pass; instead he postulated circular pores of greater or less diameter. Descartes' theory was just another example to Pitcairne of unjustified speculations into the structure of bodies and the causes of phenomena that had the same status as Aristotelian qualities. These speculations he had sought to circumvent by promoting his new mathematical physic in his *Oratio* of 1692.

Brown and Eizat were easy targets for Pitcairne's disciple George Hepburn. In *Tarrugo unmasked* (1695) Hepburn praised his master's attempts to adopt the methods of Newtonian astronomers in medical inquiries. Hepburn agreed with Pitcairne that the search for physical causes had only led to the division of physicians into sects. Instead of the philosophies of Aristotle, Descartes and Paracelsus, Hepburn urged physicians to be guided by the works of mathematicians like Euclid, Apollonius, Archimedes and Newton and doctors such as Borelli and Bellini. Eizat had made the mistake of incorporating Cartesian theories and metaphysics into his medicine and Hepburn made the association between Eizat and Aristotle all too clear in this treatise.

> That which makes this Scribler so much concern'd for Physical Causes is because he has learn'd a little of Aristotles Philosophy, which is nothing but a Metaphysical discourse, that is, a quibbling and speaking nonsense about physical Causes, and this he would have pass for good reasoning in Medicine.[121]

For Hepburn, Galen and Hippocrates were also guilty of introducing uncertain hypotheses into medicine; they had thus introduced the sectarian philosophy into medicine.[122] Only a mathematical physic grounded in geometry could produce certainty and avoid faction.

Part of the explanation for the popularity of Newtonian natural philosophy among Scottish Episcopalians in the 1690s must be sought in the political and religious contexts of post-1688 Scotland. Those like Gregory and Pitcairne who opposed the Presbyterian interest and came from Episcopalian backgrounds were more receptive to new mechanical philosophies (in their case Newtonian natural philosophy) than many of their Presbyterian opponents. While Pitcairne's and Gregory's image of the Presbyterian as a theocratic biblical fanatic and

proponent of scholastic philosophy was constructed in the middle of battles for political and religious hegemony in Scotland, such a labelling had an historical foundation. In response to the religious enthusiasm of the sects, many Scottish Episcopalians like Pitcairne and Gregory placed great value on a natural theology grounded on the book of nature. For them the orderly operation of the Newtonian universe provided ample evidence for the existence of God, unlike the inner illuminations of the religious enthusiast or the a-priori metaphysical arguments of Descartes. In this respect Scottish Episcopalians differed from their English High-Church allies who were alarmed with the threat such a natural theology could pose to scripture. In addition, Scottish Newtonians were receptive to the *Principia*, particularly since Newton's mathematical natural philosophy was seen as ideologically useful against Presbyterian sectarianism and vulgar plebeian empiricism. Only by understanding the political and religious environment in which Pitcairne, Gregory and their followers worked can one comprehend why most Newtonians who opposed the post-1688 political and religious settlement in Britain came from Scotland.

The Pitcairne/ Gregory group had a significant impact on the transmission of Newtonian ideas to England. While Hepburn, Cheyne and Cockburn immigrated south establishing their own medical practises, the circle of Scottish Newtonians centred around Gregory at Oxford, including John Keill, John Arbuthnot and the Englishman John Freind, helped to popularise Newtonian natural philosophy at conservative Christ Church, home of Francis Atterbury the leader of the High-Church movement, and throughout the university as a whole. At Oxford Newtonian natural philosophy was seen as the best defence against the materialist philosophies of Descartes, Hobbes and Leibniz, and Newton's own

heterodox views on the Trinity were ignored or segregated from the positive orthodox aspects of his thought. In addition, Newtonian natural philosophy was considered as a revival of ancient wisdom and was thus useful for the Christ Church wits in the defence of the ancients and traditional learning. It is to this story that we now must turn.

REFERENCES

[1] Margaret Jacob, *The Newtonians and the English Revolution* (Ithaca, 1976). Jacob's claim of a close connection between Newtonianism and Whiggery is largely supported in such works as: James Force, *William Whiston: honest Newtonian* (Cambridge, 1985); John Gascoigne, *Cambridge in the age of the enlightenment* (Cambridge, 1989); Richard Olson, "Tory-High Church opposition to science and scientism in the eighteenth century: the works of John Arbuthnot, Jonathan Swift and Samuel Johnson," in J.G. Burke (ed.), *The uses of science in the age of Newton* (California, 1983), 171-204; Steven Shapin, "Of gods and kings: natural philosophy and politics in the Leibniz-Clarke disputes," *Isis*, lxxxii (1981), 187-215; Larry Stewart, "Samuel Clarke, Newtonianism and the factions of post-revolutionary England," *Journal of the history of ideas*, xlii (1981), 53-72 and "Seeing through the scholium: religion and the reading of Newton in the eighteenth century," *History of science* xxxvi (1996), 123-165; M. Benjamin, "Medicine, morality and the politics of Berkeley's tar-water," in A. Cunningham & R. French (eds.), *The medical enlightenment of the eighteenth century* (Cambridge, 1990), 165-193; Chris Wilde, "Hutchinsonianism, natural philosophy and religious controversy in eighteenth century Britain," *History of science* xviii (1980), 1-24 and "Matter and spirit as natural symbols in eighteenth century British natural philosophy," *British journal for the history of science*, xv (1982), 99-131. Tories greeted James II's flight to France and replacement by William and Mary with concern. The Glorious Revolution of 1688 challenged Tory doctrines of absolute monarchy and non-resistance while giving countenance to contract theories of government supported by Whigs. Many Jacobites – those who could not support the post 1688 regime – remained loyal to James II in exile in France.

[2] Anita Guerrini, "The Tory Newtonians: Gregory, Pitcairne and their circle," *Journal of British studies*, xxv (1986), 288-311. Whigs supported the post 1688 political and religious settlement and were more willing to put limits on the rights of monarchs than Tories. They were allied with Low-Church Anglicans or Latitudinarians. Known as friends of dissent, Latitudinarians downplayed divisions between themselves and

religious nonconformists about church structure and religious ceremonies in an effort to comprehend dissenters within the Anglican Church.

[3] J.R.R. Martin, "Explaining John Freind's *History of Physick*," *Studies in history and philosophy of science*, xix (1988), 399-418. Allied with the Tories, English High-Churchmen opposed the religious toleration of dissenters secured by the Toleration Act of 1689. They saw the acceptance of Anglican articles and creeds as necessary for salvation and placed great emphasis on the divine nature of Episcopal authority. In their view, religious non-conformity should be met with disciplinary action. Like Anglican divines (both Low and High-Church), Scottish Episcopalians believed in the divine authority of bishops. Scottish Presbyterians who rejected the authority of bishops opposed them. While England and Scotland had the same monarch they were both separate kingdoms before the Act of Union in 1707. Each nation had its own political/ religious cultures and traditions.

[4] Simon Schaffer, "The Glorious Revolution and medicine in Britain and the Netherlands," *Notes and records of the Royal Society of London*, xliii (1989), 167-190.

[5] Anita Guerrini, *Obeisity and depression in the enlightenment. The life and times of George Cheyne* (Norman, 2000), esp chaps 2-3.

[6] For a discussion of the relationship between natural philosophy and religious enthusiasm see M. Heyd, *"Be sober and reasonable": The critique of enthusiasm in the seventeenth and early eighteenth centuries*. (Leyden, 1995).

[7] J.C.D. Clark, *English society 1660-1832*, (2nd ed., Cambridge, 2000); Geoffrey Holmes, *British politics in the age of Anne*, (revised ed., London, 1987), 6.

[8] H.T. Dickinson, *Liberty and property. Political ideology in eighteenth century Britain* (New York, 1977), esp. chaps 1 & 2.

[9] Geoffrey Holmes, *op. cit.* (ref 7), 97.

[10] For a good survey of High-Church thought and the differences between High and Low Churchmen see Robert D. Cornwall, *Visible and apostolic. The constitution of the church in High-Church Anglican and Non-Juror thought* (Newark, 1993)

[11] For the notion of a High-Church ethos see Jeffrey S. Chamberlain, *Accommodating High-Churchmen. The clergy of Sussex*, (Chicago, 1997), chap. 1; For controversies in convocation see G.V. Bennett, *The Tory crisis in church and state 1688-1730: the career of Francis Atterbury Bishop of Rochester* (Oxford, 1975).

[12] Barbara Shapiro, "Latitudinarianism and science in seventeenth century England," *Past and present* xl (1968), 16-41; Margaret Jacob, *op. cit.* (ref 1); J.R. Jacob & M.C. Jacob, "The Anglican origins of modern science: the metaphysical foundations of the Whig constitution," *Isis*, lxxi (1980), 251-267; J. Gascoigne, *op. cit.* (ref 1); S. Shapin, *op. cit.* (ref 1), 187-215.

[13] R. Olson *op. cit.* (ref 1), 171-204; L. Stewart, "Samuel Clarke" (ref 1), 53-72 and "Seeing through the scholium" (ref 1), 123-165; M. Benjamin, *op. cit.* (ref 1), 165-193; Chris B. Wilde, "Hutchinsonianism" (ref 1), 1-24 and "Matter and spirit" (ref 1), 99-131.

[14] For Trinitarian controversies in the 1690s see Gerard Reedy, *The Bible and reason: Anglicans and scripture in late seventeenth-century England* (Philadelphia, 1985), chap 6. Locke's views on the Trinity are thoroughly discussed in John Marshall, "Locke, Socinianism, 'Socinianism' and Unitarianism," in M.A. Stewart (ed.), *English philosophy in the age of Locke* (Oxford, 2000), 111-183.

[15] Tim Harris, "Reluctant revolutionaries? The Scots and the Revolution of 1688-89," in H. Nenner (ed.), *Politics and the political imagination in later Stuart Britain* (Rochester, 1997), 97-117, p.99.

[16] Bruce Lenman, "The Scottish Episcopal clergy and the ideology of Jacobitism," in E. Cruickshanks (ed.), *Ideology and conspiracy: aspects of Jacobitism* (Edinburgh, 1982), 36-48, p.46. For a good discussion of the relationship between Scottish Episcopalianism and Jacobitism see Daniel Szechi, *The Jacobites: Britain and Europe* (Manchester, 1994).

[17] For a good dicussion of the social dimension of religious disputes during this period see T.C. Smout, *A history of the Scottish people 1560-1830* (London, 1969), esp. chap. 3.
[18] *Ibid.*, chaps. 3-4; J.H.S. Burleigh, *A church history of Scotland* (London, 1960), chaps. 4-5
[19] Julia Buckroyd, "Anti-clericalism in Scotland during the Restoration," in N. Macdougall (ed.), *Church, politics and society: Scotland 1408-1929* (Edinburgh, 1983), 167-185, p.180.
[20] G.D. Henderson, *The burning bush: studies in Scottish church history* (Edinburgh, 1957), chaps. 6-8; James and George Garden were influenced by the mystical writings of the French women Madame Bourignon and Madame Guyon. See G.D. Henderson, *Mystics of the North-east* (Aberdeen, 1934).
[21] For Tory mysticism in the 1730s and 40s see Simon Schaffer, "The consuming flame: electrical showmen and Tory mystics in the world of goods," in J. Brewer & R. Porter (eds), *Consumption and the world of goods* (London, 1993), 189-225.
[22] John Morgan, *Godly learning. Puritan attitudes toward reason, learning and education, 1560-1640*, (Cambridge, 1986), 308.
[23] Hugh Trevor-Roper, *Religion, the reformation and social change*, (3rd ed., London, 1984), 231.
[24] *Ibid;* Hugh Trevor-Roper, "The Scottish enlightenment," *Studies on Voltaire and the eighteenth century* lviii (1967), 1635-1658. For Merton see "Science, technology and society in seventeenth century England," *Osiris*, iv (1938), 360-632. Trevor-Roper believes the origins of the English Enlightenment were, in part, due to a reaction to Calvinism. For interesting comments in this respect see J.G.A. Pocock, *Barbarism and enlightenment. The enlightenments of Edward Gibbon, 1737-1764* (Cambridge, 1999), 8.
[25] For the connection between Episcopalians and science during the Restoration see Hugh Ouston, "York in Edinburgh: James VII and the patronage of learning in Scotland, 1678-1688," in J. Dwyer, R.A. Mason & A. Murdoch (eds), *New perspectives on the politics and culture of early modern Scotland* (Edinburgh, 1982), 133-155.
[26] Roger L. Emerson, "Natural philosophy and the problem of the Scottish enlightenment," *Studies on Voltaire and the eighteenth century*, ccxlii (1986), 243-291. For a similar analysis see his "Sir Robert Sibbald, Kt, the Royal Society of Scotland and the origins of the Scottish enlightenment," *Annals of science*, xlv (1988), 41-72
[27] Christine M. King, "Philosophy and science in the arts curriculum of the Scottish universities in the seventeenth century," (Ph.D thesis, University of Edinburgh, 1974).
[28] Some of Pitcairne's strongest opponents were medical doctors such as Andrew Brown and Edward Eizat, men who supported the new post 1688 regime in Scotland.
[29] For important comments in this respect see James K. Cameron, "Theological controversy: a factor in the origins of the Scottish enlightenment," in R.H. Campbell & A.S. Skinner (eds), *The origins and nature of the Scottish enlightenment* (Edinburgh, 1982), 116-130.
[30] Nicholas Phillipson, "Culture and society in the eighteenth century province: the case of Edinburgh and the Scottish enlightenment," in L. Stone (ed.), *The university in society*, (London, 1975), ii, 407-448 and John Christie, "The rise and fall of Scottish science," in M. Crosland (ed.), *The emergence of science in western Europe* (London, 1975), 111-126.
[31] Nicholas Phillipson, *op. cit.* (ref 30), 429-430.
[32] The circumstances for Pitcairne's resignation are still unclear. One theory is that his future wife, the daughter of Sir Archibald Stevenson refused to move to Leyden. Another is that Pitcairne's anti-Presbyterianism was not welcome in Calvinist Holland. See G.A. Lindeboom, "Pitcairne's Leyden interlude described from the documents," *Annals of science*, xix (1963), 273-284.
[33] For information on Pitcairne's medical theory see Theodore Brown, *The mechanical philosophy and the animal oeconomy* (New York, 1981); Anita Guerrini, "Archibald

Pitcairne and Newtonian medicine," *Medical history*, xxxi (1987), 70-83 and Lester King, *The philosophy of medicine: the early eighteenth century* (Cambridge, 1978), chap. 5.

[34] For disputes between Pitcairne and his medical opponents see Andrew Cunningham, "Sydenham vs Newton: the Edinburgh fever dispute of the 1690s," in W.F. Bynum and V. Nutton (eds), *Theories of fever from antiquity to the enlightenment* (London, 1981), 71-98; Stephan Stigler, "Apollo mathematicus: a story of resistance to quantification in the seventeenth century," *Proceedings of the American philosophical society*, cxxxvi (1992), 93-126 and W.B. Howie, "Sir Archibald Stevenson, his ancestry, and the riot in the College of Physicians of Edinburgh," *Medical history*, xi (1967), 269-284.

[35] The first translation was in 1715. For this essay I will be referring to the 2nd edition of this translation. See Archibald Pitcairne, *The works of Archibald Pitcairne*, trans by G. Sewell and J.S. Desaguliers (London, 1727).

[36] See the numerous letters between Pitcairne and Mar in W.T. Johnson (ed.), *The best of our own: letters of Archibald Pitcairne 1652-1713* (Edinburgh, 1979).

[37] For an interesting comment on the close relationship between Pitcairne and Gregory see V.S. Kirsanov, "The earliest copy in Russia of Newton's *Principia*: is it David Gregory's annotated copy," *Notes and records of the Royal Society of London*, xlvi (1992), 203-218.

[38] A.G. Stewart, *The academic Gregories* (Edinburgh, 1901), 52; For Gregory's teaching at Edinburgh see Christina Eagles, "David Gregory and Newtonian science," *British journal for the history of science*, x (1977), 216-225.

[39] A.G. Stewart, *op. cit.* (ref 38), 58; Christina Eagles, "The mathematical works of David Gregory," (PhD thesis, University of Edinburgh, 1977), 40. The commission required those holding office to swear loyalty to William and Mary and subscribe to the Confession of Faith. For a pro Episcopalian account of the proceedings see Alexander Monro, *Presbyterian inquisition; as it was lately practised against the professors of the Colledge of Edinburgh* (London, 1691)

[40] Speaking of Gregory, Newton wrote to Arthur Charlett that he had "performed his duty at Edinburgh wth credit as I hear and is respected the greatest mathematician in Scotland and that deservedly so far as my knowledge reaches." Newton to Charlett, July 27, 1691. H.W. Turnbull (ed.), *The correspondence of Isaac Newton*, iii (Cambridge, 1961), 155.

[41] Both of these works were translated posthumously into English in 1715. See D. Gregory, *Dr. Gregory's elements of catoptrics and dioptrics*, trans. W, Browne (London, 1715) and D. Gregory, *Elements of astronomy physical and geometrical* (London, 1715).

[42] Most of this memorandum was published by W.G. Hiscock (ed.) as *David Gregory, Isaac Newton and their circle* (Oxford, 1937).

[43] Robert Wodrow, *Analecta: or materials for a history of remarkable providences*, (Edinburgh, 1842-43), ii 255.

[44] Alexander Monro, *op. cit.* (ref 39), 28, 39.

[45] Thomas McCrie (ed.), *The correspondence of the rev Robert Wodrow*, (Edinburgh, 1842-43), i, 163. Translation: the word of God remains to eternity

[46] Edward Eizat, *Apollo mathematicus: or the art of curing diseases by the mathematics according to the principles of Dr. Pitcairn..... to which is subjoined a discourse of certainty, according to the principles of the same author* (London, 1695), 10-11. The *Solutio problematis* was originally published in Edinburgh in 1688 and was republished in Pitcairne's works. See A. Pitcairne, *op.cit.* (ref 35), 139-167.

[47] Thomas Halyburton, *Natural religion insufficient, and revealed necessary to man's happiness in his present state or a rational enquiry into the principles of the modern deists* (Edinburgh, 1714), 12.

[48] Until the nineteenth century the terms theism and deism were used interchangeably. The *Epistola* was published anonymously but was likely written by Pitcairne. Gregory claimed it was. See W.G. Hiscock, *op. cit.* (ref 42), 35-6. Halyburton's lecture on

Pitcairne's *Epistola* (published in 1710) was prefixed to Halyburton's *Natural religion insufficient* in 1714.

[49] For Craige see Richard Nash (ed.) *John Craige's mathematical principles of Christian theology*, (Carbondale, 1991).

[50] Pitcairne to Gray, Sept, 1694. W.T. Johnston (ed.), *op. cit.* (ref 36), 3.

[51] Pitcairne to Gray, Nov 24, 1694, *Ibid.*, 19.

[52] Pitcairne to Gregory, Feb 25, 1706, *Ibid.*, 43.

[53] Isaac Newton, *Principia*, eds. I.B. Cohen and A. Whitman (Berkeley, 1999), 398.

[54] Quoted in Alan Cook, *Edmund Halley. Charting the heavens and seas* (Oxford, 1998), 247.

[55] Quoted in Christina Eagles, *op. cit.* (ref 39), 41.

[56] Thomas Halyburton, *op. cit.* (ref 47), 17. This quote is found in Nye's *Discourse concerning natural and revealed religion* (London, 1696), 199.

[57] Gerard Reedy, *op. cit.* (ref 14), 124.

[58] H.W. Turnbull (ed.), *op. cit.* (40), iii, 108.

[59] For an excellent study on this and related aspects of Newton's thought see John Gascoigne, " 'The wisdom of the Egyptians' and the secularisation of history in the age of Newton," in S Gaukroger (ed.), *The uses of antiquity. The scientific revolution and the classical tradition* (Dordrecht, 1991), 171-212 and Robert Iliffe, " 'Is he like other men.' The meaning of the *Principia Mathematica* and the author as idol," in G. Maclean (ed.), *Culture and society in the Stuart Restoration* (Cambridge, 1995), 159-176. My thanks to Dr. Iliffe for a chapter "Stonehenge, 'the true temple of God': Newton and the origins of idolatry" of a forthcoming book of his. Also see Frank Manuel, *Isaac Newton historian* (Cambridge, 1963), chaps. 8-9 and *The religion of Isaac Newton* (Oxford, 1974), chap. 3.

[60] For Locke and the Trinity see Gerard Reedy, *op. cit.* (ref 14), chap 6 and John Marshall's *op. cit.* (ref 14), 111-183.

[61] Gerard Reedy, *op. cit.* (ref 14), 21.

[62] For anti-clericalism in the early eighteenth century see J.A.I. Champion, *The pillars of priestcraft shaken. The Church of England and its enemies* (Cambridge, 1992). Toland is examined in Robert E. Sullivan, *John Toland and the deist controversy* (Cambridge, 1982), esp. chap 3.

[63] H.W. Turnbull (ed.), *op. cit.* (ref 40), iii, 338.

[64] Pierre Desmaizeaux (ed.) *A collection of several pieces of Mr John Toland*, (London, 1726), i, vi-viii.

[65] *Ibid.*, ii, 301-8.

[66] Christ Church MSS. 163. This manuscript appears under David Gregory's (the astronomer) name in the Christ Church manuscript catalogue.

[67] W.G. Hiscock (ed.) *op. cit.* (ref 42), 28-29.

[68] *Ibid.*, 29. In his journal he wrote for Dec 17, 1705: It would be very acceptable just now to write a Epitome of the History of Scotland, as the Vouchers of the Constitution of the Kingdom, which ought to be the main design of the work.

[69] Christ Church MSS., 163., f. 10v.

[70] Pitcairne's dislike of the social Puritanism of the Presbyterians can be seen in *Babell* where the Presbyterians accuse the Episcopalians of such ridiculous sins as celebrating Christmas with good food and drink and not reading Calvin enough. For a list of Episcopalian sins see Archibald Pitcairne, *Babell* ed.. G.R. Kinloch, (Edinburgh, 1830), 15-25.

[71] Archibald Pitcairne, *The assembly* (London, 1722), 46-47. In the 1722 edition the passage reads "have confinement to sense and reason." The 1752 and 1766 Edinburgh editions of the play correctly uses the word hate instead. Obviously given the context of the passage the word "have" is a misprint.

[72] *Ibid.*, 107.

[73] *Ibid.*, 86.

[74] *Ibid*., 84.
[75] *Ibid*., 54.
[76] Thomas Halyburton, *op. cit*. (ref 47), 23.
[77] Thomas McCrie (ed.), *op. cit*. (ref 45), ii, 77-78.
[78] Indeed, among the sins that the General assembly accuses the Episcopalians of in *Babell* are belief in free will and denial of predestination. Archibald Pitcairne, *op. cit*. (ref 70), 21-22.
[79] Thomas Halyburton, *op. cit*. (ref 47), 15.
[80] Thomas McCrie (ed.), *op. cit*. (ref 45), ii, 392.
[81] *Ibid*., iii, 236. See L. Stewart, *op. cit*. (ref 1), "Samuel Clarke", 53-72 for Clarke and Newtonian metaphysics.
[82] Thomas McCrie (ed.) *op. cit*. (ref 45), iii, 262.
[83] Archibald Pitcairne, *Epistola Archimedis ad regem Gelonem* (Edinburgh, 1710), 13-14. In the *Epistola* Pitcairne alluded to the falsity of the Trinity in a discussion of Hannibal. Pitcairne stated that "on testimonies also it is believed that he [Hannibal] defeated the Romans at Ticinum, then at the Trebia, and recently in a great battle at Lake Trasimene. But if anyone should assert that Hannibal fought those three battles at the same time using one and the same army, he would not find credence among the knowledgable (for that thing would overcome the strength of testimonies) although he might even, to extricate himself, wish to persuade that there was indeed just one Hannibal but he alone had three different generals, inside himself, namely, the Ticinese, the Trebian, and the Trasumemian, as different as the locations of the places where the fighting took place are different….. But that he, one man, be divided into three responds to no postulate." My thanks to Professor J.B. Hall of the Classics Department, University of Leeds for help with the translation.
[84] Indeed, Pitcairne along with Allan Ramsay were part of the patriotic Easy Club that promoted Scoto-Latinism as part of a project to defend Scottish highland pastoral culture against English assimilation. See Murray G.H. Pittock, *Poetry and Jacobite politics in eighteenth-century Britain and Ireland* (Cambridge, 1994), 154.
[85] For the history of experimental Newtonianism see I.B. Cohen, *Franklin and Newton* (Philadelphia, 1956) and Robert E. Schofield, *Mechanism and materialism* (Princeton, 1970) For popular Newtonian experimental lectures see Larry Stewart, *The rise of public science* (Cambridge, 1992).
[86] This is an important aspect of what I.B. Cohen has termed the Newtonian style. See Isaac Newton, *op. cit*. (ref 53), 149-150.
[87] Bruce Lenman, *op. cit.* (ref 16), 36-48.
[88] Quoted in David Reid (ed.), *The party-coloured mind. Prose relating to the conflict of church and state in seventeenth century Scotland* (Edinburgh, 1982), 154.
[89] While Filmer argued in his *Patriarcha* for the decent of kingly authority from Adam, Hobbes based his theory of absolute monarchy on a contractual basis. See Robert Filmer, *Patriarcha and other writings*, ed., J.P. Sommerville (Cambridge, 1991) and Thomas Hobbes *Leviathan*, ed., R. Tuck (Cambridge, 1991).
[90] Isaac Kramnick, *Bolingbroke and his circle: the politics of nostalgia in the age of Walpole* (Cambridge, Mass, 1968), esp chap. 5.
[91] Steven Shapin & Simon Schaffer, *Leviathan and the air-pump: Hobbes, Boyle and the experimental life* (Princeton, 1985), esp. chap. 3.
[92] For the potential discursive power of the *Principia* see Robert Markley, "Representing order: natural philosophy, mathematics, and theology in the Newtonian revolution," in N. Katherine Hayles (ed.), *Chaos and order: complex dynamics in literature and science* (Chicago, 1991), 125-148.
[93] For interesting comments on Pitcairne in this respect see Simon Schaffer, *op. cit*. (ref 4), 176.
[94] M. Heyd, *op. cit*. (ref 6), 139.
[95] Archibald Pitcairne, *op. cit*. (ref 83), 14

[96] Translation in Archibald Pitcairne, *op. cit.* (ref 35), 5-22. Gregory's inaugural lecture has been recently translated. See P.D. Lawrence & A.G. Molland, "David Gregory's inaugural lecture at Oxford," *Notes and records of the Royal Society of London* xxv (1970), 143-178.
[97] For this aspect of Pitcairne's medical theories see Anita Guerrini, *op. cit.* (ref 34), 70-83; Stephan Stigler, *op. cit.* (ref 34), 93-126; Lester King, *op. cit.* (ref 34), chap. 5.
[98] Archibald Pitcairne, *op. cit.* (ref 35), 8-9.
[99] P.D. Lawrence & A.G. Molland (eds.), *op. cit.* (ref 96) 143-178
[100] *Ibid.*, 168.
[101] Archibald Pitcairne, *op. cit.* (ref 35), 8.
[102] *Ibid.*, 11.
[103] P.D. Lawrence & A.G. Molland, *op. cit.* (ref 96), 166-7. My italics
[104] E.J. Dyksterhuis, *Archimedes* (Copenhagen, 1956), chap. 1; W.R. Laird, "Archimedes among the humanists," *Isis*, lxxxii (1991), 629-638.
[105] Gregory's elitism was also shared by Newton. See Robert Iliffe, *op. cit.* (ref 59), 175.
[106] Anita Guerrini, *op. cit.* (ref 2), 303-305.
[107] David Shuttleton, " 'A modest examination': John Arbuthnot and Scottish Newtonians," *British journal for eighteenth-century studies*, xviii (1995), 47-62.
[108] For Brown and Eizat see Andrew Cunningham, *op. cit.* (ref 34), 71-98 and Steven Stigler, *op. cit.* (ref 34), 93-126.
[109] For Sydenham's political views see Andrew Cunningham, "Thomas Sydenham: epidemics, experiment and the 'good old cause'" in Roger French & Andrew Wear (eds), *The medical revolution of the seventeenth century* (Cambridge, 1989), 164-190.
[110] Andrew Brown, *A vindicatory schedule concerning the new cure of fevers* (Edinburgh, 1691), 64.
[111] *Ibid.*, 64
[112] Edward Eizat, *op. cit.* (ref 46), 22-23.
[113] Andrew Brown, *op. cit.* (ref 110), 39.
[114] Edward Eizat, *op. cit.* (ref 46), 91.
[115] Cheyne urged the publication of such a work in "An Essay concerning the improvements of the theory of medicine." See George Cheyne, *A new theory of acute and slow continu'd fevers..... to which is prefix'd an essay concerning the improvements of medicine* (London, 1702).
[116] George Cheyne, *Remarks on two late pamphlets written by Dr. Oliphant against Dr. Pitcairn's Dissertations, and the New Theory of Fevers* (Edinburgh, 1702), 6
[117] *Ibid.*, 9.
[118] David Shuttleton, *op. cit.* (ref 107), 47-62.
[119] [John Arbuthnot?], *A modest examination of a late pamphlet entituled, Apollo Mathematicus* (Edinburgh, 1696), 9-10.
[120] This work was originally published at Leyden in 1693. It can be found in Archibald Pitciarne, *op. cit.* (ref 35), 33-65.
[121] George Hepburn, *Tarrugo unmasked or an answer to a late pamphlet intituled Apollo Mathematicus* (Edinburgh, 1695), 15.
[122] *Ibid.*, pref. vi.

Newtonianism at Christ Church: Newtonian natural philosophy and the ancients-moderns controversy

When David Gregory moved to Oxford in 1692 he came to an institution noted for its Tory and High-Church principles. Many individuals there had been unable or reluctant to submit to the new regime of William and Mary and opposed the Toleration Act of 1689 that granted dissenters such as Presbyterians, Independents, Baptists and Quakers the right to publicly worship outside the Anglican Church. When Francis Atterbury of Christ Church published his *Letter to a Convocation man* in 1697, a work that argued for the regular sitting of Anglican convocation to censor and regulate the spread of heterodox ideas, he initiated a High-Church revolt against Whig Low-Church Anglican bishops that led to bitter divisions in the Anglican Church for the next two decades.[1] The High-Church movement sought to control the spread of heterodox religious ideas by holding regular sittings of Anglican Convocation. Anglican orthodoxy appeared threatened by the spread of religious dissent, freethinking, the popularity of the new philosophies of Descartes, Hobbes and Spinoza as well as Low-Churchmen within the Church of England. By placing emphasis on a few fundamentals necessary for salvation and knowable through our reason, Low-Churchmen appeared linked to freethinkers who banished mysteries like the Trinity from religion. High-Churchmen believed that by placing more emphasis on faith and revelation (as interpreted by bishops) rather than on reason this trend could be reversed. As previously noted, this sceptical attitude toward the use of reason in religious apologetics differed significantly from Scottish Episcopalians and their supporters. While Gregory might have enjoyed a good joke or two with

Pitcairne about the biblical dogmatism of their Presbyterian opponents at Edinburgh such public irreverence would not have been appreciated at Oxford.

Yet despite the thorny ground upon which the natural philosopher had to tread at Oxford, natural philosophy was widely taught and Newton praised for his piety, modesty and reverence for the ancients. Within specific contexts Oxford Newtonians projected this image of Newton to a Tory High-Church audience and adopted political and religious stances commensurate with the politics of their college. The extent to which such allegiances were the product of sincere belief is debatable. While Gregory remained aloof from political and religious controversy, younger Scots like his student John Keill and the physician John Arbuthnot vigorously defended the High-Church cause. Gregory became a member of Christ Church around 1700 and Keill in 1703. Along with the physician and classicist John Freind they formed a Newtonian coterie under the patronage of the Dean Henry Aldrich who was interested in mathematics, music and architecture.[2] Gregory and Keill joined Christ Church shortly after the most virulent disputes in the ancients-moderns controversy in which the Tory Christ Church literary men Francis Atterbury, George Smalridge, William King, John and Robert Friend, Anthony Alsop and Charles Boyle defended ancient learning against advocates for the moderns led by the Whigs William Wotton and Richard Bentley. Newtonians at Christ Church also participated in the controversy and were quick to appropriate Newton for the cause of the ancients; they claimed ancient Egpytians and Greeks knew much of the Newtonian system. Newton could thus be portrayed as a restorer of ancient lost knowledge. Newton very much believed this himself,[3] but I will suggest the appeal of such an idea was strong at Oxford, especially at Christ Church, because it allowed Tories to

portray Newton as a champion of the ancients. They sought to depict Newton as a modest natural philosopher and not as a vain speculative thinker; he did not seek to overthrow all previous systems of natural philosophy and, by implication, established religion.

This chapter will begin with a survey of High-Church Anglicanism at Oxford followed by an analysis of the ancient-moderns controversy. Christ Church Tory Newtonians along with the literary wits of their college sought to defend the ancients against the vanity of the moderns. The works of Tory satirists such as Swift, Pope, Gay and Arbuthnot will also be examined to illustrate what the modern critic and defenders of the new philosophy had come to represent for supporters of the ancients. I will then show how Gregory, Keill and Friend argued that Newtonian natural philosophy represented a revival of ancient knowledge. By emphasising the similarities between his natural philosophy and that of the ancients, Newton was able to minimize his own contributions. Indeed, Christ Church scholars saw this as evidence that Newton was a modest natural philosopher and not a vain modern, and this view was further bolstered by his cautious experimental methodology. Lastly the relationship between Newtonian natural philosophy and religion will be explored during this period – how Newton's Tory followers at Christ Church and elsewhere (with the exception of Gregory) disassociated Newtonian natural philosophy from the world-making and millenarianism of Arians like William Whiston, ignoring in the process Newton's own anti-Trinitarianism.

Francis Atterbury, Christ Church and High-Church Anglicanism

After the Glorious Revolution Christ Church was a hotbed for Toryism. By far the most influential of college heads during this period was Henry Aldrich dean of Christ Church. For a "generation down to his death in 1710, he was to represent in the university the most uncompromising form of old-fashioned Toryism."[4] Francis Atterbury, Aldrich's replacement, was the leader of the High-Church party during the reign of Queen Anne. Under the influence of Aldrich and Atterbury Christ Church remained a staunchly Tory and High-Church college. In some cases disaffection with the current regime led to Jacobitism within the college. In an ode to David Gregory, Anthony Alsop revealed both his and Gregory's desire for a return to the Stuart past:

> You can see (not without tears springing to your eyes) the sad ruins of our royal house, our princes thrust from their ancestral seats and again exiled. But if we can trust your stars, if we poets are not unreliable prophets, and do not throw out empty songs to be torn apart by tempests, then look – the time is at hand, look the day will come, when the name of Stuart will again raise its head to heaven, and possess power for all time.[5]

After the Hanoverian Succession Atterbury and his Christ Church colleague John Freind were implicated in Jacobite plots.

Of more pressing concern to men like Atterbury was the threat that the post-revolutionary religious settlement posed for the Anglican Church. Between 1691-1710 no less than 2536 dissenting meetinghouses were licensed.[6] Socianianism and Arianism were promoted in the anti-Trinitarian controversies of the 1690s while deists, sceptics and freethinkers such as Charles Blount, Anthony Collins, Matthew Tindal and John Toland criticised the Anglican religious hierarchy's

promotion of mystery and its monopolization of authoritative claims to divine knowledge.[7]

Atterbury and other churchmen viewed this assault on the established church as dangerous since in eighteenth century England political and social authority still primarily had a religious foundation. As Jonathan Clark has argued, ideas of divine right, passive obedience and patriarchy tenaciously persisted in a society dominated by patrician elites. A Christian language of hierarchy justified an English society composed of ranks and orders; political obedience to the monarchy and aristocracy was seen as a religious duty justified by God's providential ordering of human society. As there was hierarchy in society so too was there a hierarchical structure in the Anglican Church whose authority was transmitted through a line of apostolic succession, a line that was seen as evidence of its divine appointment. In a similar manner, political and social authority had its origins in the distant past.[8]

One of the first to declare the 'church in danger' from those who denied religious mystery, the authority of scripture and the legitimacy of the Anglican religious establishment was Francis Atterbury. His *Letter to a Convocation man* (1697) and *The rights, powers and privileges of an English Convocation* (1700) argued that Anglican Convocation had the right, independent of state decree, to sit regularly in order to censor and punish heretical ideas. Atterbury's theory of Convocation was welcomed by the High-Church clergy who composed the majority of the lower house of Convocation, but not by Whig Low-Churchmen such as Archbishops Tillotson and Tenison, who composed the upper house, supported the post 1688 religious settlement and feared the regular convening of Convocation would lead to unnecessary religious conflict. The *Letter to a*

Convocation Man attracted much attention at Christ Church. Writing to Walter Gough, George Smalridge noted the popularity of the *Letter* at the college: "it is much talked of, and much liked here. We are not able to guess at the Author: some will have it to be our Dean's [Henry Aldrich], but I am certain they are in the wrong; some have done me the honour to farther it on me."[9]

In the first decade of the eighteenth century Atterbury emerged as the leading clerical defender of Tory High-Churchmanship. During periods of Tory strength in London, Atterbury and his followers in the lower house attempted to censure and pursue disciplinary action against heterodox books and authors. In 1701 High-Churchmen in Convocation tried to suppress Toland's *Christianity not mysterious* (1696) and later Whiston's and Clarke's Arian *Primitive Christianity reviv'd* (1711) and *Scripture doctrine of the Trinity* (1712). Whig Low-Church bishops in the upper house continually frustrated these efforts although Whiston's public Arianism did lead to his expulsion from the Lucasian chair at Cambridge. After the death of Aldrich in 1710 and the rise to power of the Tory ministry of Robert Harley and Henry St. John (Bolingbroke), Atterbury was appointed Dean of Christ Church and took an active part in the promotion of the new Tory ministry, writing along with Swift and John Freind in Harley's *Examiner*.[10] Indeed, hopes were high for a Tory High-Church counter-revolution in the wake of the 1710 electoral victory.

The belief that the 'church was in danger' from deists, freethinkers and anti-Trinitarians was based on the fear that a solely rational religion threatened the Anglican Church's authority based on mysteries like the Trinity. Both the anti-Trinitarian heresies of Arianism and Socinianism were equally objectionable, since they together rejected the son's co-substantiality with the father and viewed

Jesus as a product of the father's creation. Socinianism even went further than Arianism by reducing Jesus to the status of a mere human. As Clark explains the denial of the Trinity could have disastrous consequences for the established church:

> if Christ were not a person of the Trinity, the doctrine of the Atonement, held Socinians, was meaningless; if man were not in need of redemption, original sin did not descend by inheritance, and man must be assumed to be both fundamentally benevolent and capable of ordering his own affairs in all respects….. A consequence of a denial that Christ exercised divine authority was that He could not institute a priesthood (whether descending by apostolic succession or not) and exercising its powers by virtue of that divine right.[11]

It is not surprising then that Atterbury declared in 1710, the same year that Whiston was expelled from Cambridge that

> the Godhead of the Holy Spirit being first denied, all supernatural operations on the hearts of men were afterwards questioned, and the grace of God ridiculed; all mysteries in Religion were exploded, as absurd and useless speculations, as implying contradictions, and meaning nothing, and therefore as incapable of becoming objects of assent to reasonable minds.[12]

The rejection of the miraculous was also evident in the attempts of natural philosophers to explain the biblical creation and the flood through various cosmological theories, a project referred to as world-making. Indeed, the last two decades of the seventeenth century witnessed several attempts to explain the history of the earth – creation, flood, millennium and final consummation of all things – according to the principles of the mechanical philosophy. Works like Thomas Burnet's *Sacred theory of the earth* (1684-1690), John Woodward's *Essay toward a natural history of the earth and terrestrial bodies* (1695) and William Whiston's *New theory of the earth* (1696) endeavoured to explain catastrophic changes in the earth's history by recourse to secondary or natural causes instead of direct divine intervention. Such speculations were often in conflict with a literal scriptural understanding of the creation and flood. For

example, Burnet claimed in his *Archaeologiae philosophicae* that his own theories on the early earth's history proved that the Mosaic history of creation was a mere fable designed for the capacities of the vulgar and not a true account of the earth's history. Regarding world-makers like Burnet, Atterbury stated also stated in 1710:

> nor are we insensible how much Religion hath suffered by vain pretences to fathom those depths of Divine Wisdom which are unsearchable, and to advance nice explication of mysteries which are inexplicable; by the misapplication of mathematical reasoning to matters of mere revelation; by the attempts made to shew how all the steps taken in that great work of Omnipotence, the creation of the world, were to be accounted for by the known laws of motion; and that the destruction of it, by the deluge, might in like manner be explained.[13]

As will be noted below, Newtonians such as John Keill criticised the world-making of Burnet and Whiston as a vain and irreligious project. World-making was also ridiculed by Tory satirists such as Swift, Pope, Gay and Arbuthnot in works like the *Memoirs of Martin Scriblerus* and the play *Three hours after marriage* (1717). However, in spite of the world-making speculations of Newtonians like Whiston, including the latter's public anti-Trinitarianism, Newton remained largely immune from attack.

Atterbury often directed his assaults against political and religious opponents within Oxford. Although the university remained staunchly Tory High-Church, Whig colleges such as Pembroke and Wadham prevented Tory High-Church hegemony from being complete. For example, fellows of All Souls such as James Tyrell and the freethinker Matthew Tindal defended the political writings of Locke and challenged the clerical establishment. Indeed, Tindal's *The rights of the Christian Church asserted* (1706) bitterly denounced the Anglican clergy and the universities for priestcraft; John Toland's controversial *Christianity not mysterious* (1696) was also likely written while he resided at Oxford. In addition,

the anti-Trinitarian controversy of the 1690s was sparked by the publication of the Oxford divine Arthur Bury's Arian *Naked gospel* in 1690.[14]

Despite the above challenges to Tory High-Church domination, Atterbury's views represented majority opinion at Oxford. When Jonathan Swift published anonymously his *Tale of the tub* (1704), a vicious satire on religious dissent and enthusiasm, the vanity of natural philosophers and of world-makers, Atterbury assumed that the author was a Christ Church man: the "authors of 'A Tale of the Tub' are now supposed generally at Oxford to be one Smith, and one Philips; the first a student, the second a Commoner, of Christ Church."[15] However, such a work could possibly have originated from Oxford colleges such as All Souls, Jesus, Balliol, Lincoln, New College and University that were led by Tory heads. If Christ Church became a centre for Tory High-Church agitation in the first decades of the eighteenth century, it was due to the influence of Atterbury and Aldrich along with the college's strong tradition of classical learning and defence of ancient knowledge. In the case of Christ Church, the defence of Anglicanism and ancient knowledge were intertwined.

Christ Church, the ancients-moderns controversy and Tory satirists

The most recent study of the debate between ancients and moderns by Joseph Levine has interpreted the dispute as largely a controversy about whether history was science or literature.[16] While most scholars involved in the dispute were literary men and not natural philosophers, I will argue that issues of natural philosophy were important as well. While a scholar's decision to support the ancients or moderns did not follow strict party lines,[17] the controversy had a

distinctive political dimension at Christ Church. Tory Christ Church wits believed they were defending ancient knowledge against the vain pretensions of the leaders of the moderns, the Whigs Richard Bentley and William Wotton. Even the Jacobite Thomas Hearne, whose enthusiasm for antiquarianism and the science of philology made him receptive to the modern notion of history as science, despised Bentley and Wotton and sided with Christ Church. Hearne described Bentley as "a known Enemy to the University of Oxford," and said of Wotton that he "was a Person of general learning, a great Talker and Braggadocio, but of little Judgement in any one particular science."[18] The vanity of the modern historian who criticised ancient historical texts was much like the modern natural philosopher that rejected the accumulative wisdom of the past.

The dispute began in earnest after the publication of the diplomat William Temple's *Essay upon ancient and modern learning* in 1692. This essay was in response to Burnet's *Sacred theory of the earth* and Fontenelle's *Digression sur les anciens et les modernes* both of which argued for the superiority of modern learning over ancient. Temple's essay was criticised by the young William Wotton in his *Reflections upon ancient and modern learning* (1694). While conceding that the ancients were superior in the fine arts, Wotton declared the moderns triumphant in the sciences. Wotton's *Reflections* were republished in 1697 and 1705. The second edition had an essay appended by Richard Bentley entitled "A dissertation upon the epistles of Phalaris." Phalaris was an ancient Sicilian tyrant. Wotton declared the *Epistles* a forgery and Bentley's "Dissertation" added more authority to this claim. Bentley's work had another aim, namely to criticise the young Christ Church scholar Charles Boyle's recently published edition of the *Epistles of Phalaris*, a man whom Bentley

considered an intellectual lightweight. Bentley's attack on the young aristocrat provoked a collective response from the Christ Church wits. *Dr. Bentley's dissertations on the epistles of Phalaris and the fables of Aesop examined* (1698) appeared under Boyle's name but was really a collaborative work of Francis Atterbury, George Smalridge, Anthony Alsop, John and Robert Freind and William King. Atterbury appears to have born the brunt of the composition.[19]

Central to the dispute over the *Epistles of Phalaris* was a debate over the purpose of history. The ancients believed the aim of history was to instruct and they urged the imitation of the lessons of classical authors; the moderns attempted to validate the claims of ancient historical texts through the new science of philology and archaeology. Christ Church with its strong connections to Westminister School put great emphasis on the uses of a classical education for a man of public affairs. For the Christ Church wits the authenticity of the *Epistles* was not as important as the historical lessons that it taught – lessons that could be put into practise by future statesmen. Indeed, the Christ Church wits did not claim with absolute certainty that the letters of the Sicilian tyrant were genuine; they would rather be handsomely mistaken "than be so Rudely and Dully in the right, as Some of his Opposers, allowing' em to be in the right, are."[20] In contrast, Bentley believed the authenticity of the letters was of utmost importance, and he used evidence of the documents being written in Attic Greek to prove they were spurious because Phalaris was the tyrant of Sicily where people spoke Doric.

What the Christ Church wits disliked most about Bentley and Wotton was their arrogance. In the examination of Bentley's dissertation on Phalaris they provided several definitions of a good and bad critic. A good critic is "Modest

and Decent in his Censures, Candid and Impartial; he treads warily, uses his Judgement much, but distrusts it more."[21] In contrast a bad critic had an "Assuming and Positive way of delivering" himself "upon Points especially not worth our Concern."[22] He also had an "itch of contradicting Great Men, or Establish'd Opinions upon very slight Grounds."[23] The vanity of the modern critic symbolised England's social and moral malaise; it was this same vanity that led individuals to reject the political authority of Kings, the religious authority of Bishops and the wisdom of past intellectuals.

The best caricatures of the vanity of the moderns can be found in the satires of Tories such as Swift, and his fellow Scriblerians Arbuthnot, Pope, Gay and Parnell. These men were supporters of the ancients in the dispute and had close links to the Christ Church wits. Swift's *Tale of the tub* (1704), which was greatly admired at Christ Church, illustrates the connection between historical criticism, modern systems of natural philosophy and political and social radicalism made by Tory defenders of the ancients. In this book modern system-makers such as Descartes and Paracelsus were targets of satire while ancient natural philosophers, with some exceptions, were praised. Intellectual vanity, seen as an expression of spiritual pride, and not natural philosophy was the principle target of ridicule. Sir Isaac Newton remained largely immune from such direct attacks, partly because, as I will argue later, Newtonian natural philosophy was viewed as a resource to defend the wisdom of the ancients.

Where did the plague of modernism come from? Swift's mentor William Temple believed its origins were recent and associated with the rise of the new seventeenth century mechanical philosophies and the rejection of past intellectual authority.

> It is by themselves confest, that till the new Philosophy had gotten Ground in these Parts of the World, which is about fifty or sixty Years date, there were but few that ever pretended to exceed or equal the Ancients; those that did, were only some Physicians, as Paracelsus and his Disciples.[24]

Temple saw Descartes and some early members of the Royal Society as particularly representative of the vain modern who rejected ancient authority. This dismissal of ancient learning supported a new linear view of history that emerged in seventeenth century England. Influenced by Bacon, apologists of the early Royal Society like Joseph Glanvil and Thomas Sprat believed knowledge could indefinitely increase over time if the proper method were followed.[25] Defenders of the ancients did not have such a view of history. For them history was cyclical – societies had a birth, growth and decay. Knowledge was not cumulative and had to be sought in the past. The belief that the wisdom of the ancients could be exceeded was evidence of the arrogance of the moderns. As Temple concluded, the ancients had a "Sense and Acknowledgment of their own Ignorance, the Imbecility of Human Understanding, the Incomprehension even of Things about us, as well as those above us." In contrast, the moderns vainly think we "shall know, not only all Natural, but even what we call Supernatural things."[26]

The vanity of the moderns and their dismissal of established religion were most cleverly portrayed in section nine ("A digression concerning the original, the use and improvement of madness in a Commonwealth") of Swift's *Tale of the tub*. Like the fictional character in Swift's satire, the religious enthusiast or dissenter Jack, modern system-makers were mad. Swift declared that if philosophers such as Epicurus, Diogenes, Apollonius, Lucretius, Paracelsus and Descartes "were now in the World, tied fast, and separate from their Followers, would in this our undistinguishing Age, incur manifest Danger of Phlebotomy,

and Whips, and Chains, and dark Chambers and Straw."[27] Madness was the cause of all revolutionary schemes. Indeed,

> if the Moderns mean by Madness, only a Disturbance or Transposition of the Brain, by Force of certain Vapours issuing up from the lower Faculties; Then has this Madness been the Parent of all those mighty Revolutions, that have happened in Empire, in Philosophy and in Religion. For, the Brain, in its natural Position and State of Serenity, disposeth its Owner to pass his Life in the common Forms, without any Thought of subduing Multitudes to his own Power, his Reasons or his Visions.[28]

Here the modern natural philosopher is portrayed as the religious enthusiast.

These caricatures, found in the *Tale* as well as the essay, *The mechanical operation of the spirit*, had historical precedent. As Charles Webster has shown, there was a close link between Bacon's writings and Puritan reformers in the Interregnum. Inspired by Bacon's belief that knowledge could be used for the relief of man's estate, men like Samuel Hartlib promoted various scientific projects with millennial zeal.[29] Descartes' could also be viewed as source of enthusiasm. His philosophical method involving deduction from innate ideas appeared highly subjective, individualistic and vain; his belief that knowledge of God was innate implied that humans had some inner experience of God like the inner light of the Quaker.[30] Swift's association of the modern philosopher and the religious fanatic was thus not surprising.

However, Swift did praise many ancient natural philosophers in his *A full and true account of the battel fought last Friday between the ancient and the modern books* appended to the *Tale of the tub*. In this battle the moderns were led by Bacon, Descartes, Gassendi, Hobbes, Paracelsus and Harvey; the ancients by Euclid, Plato, Aristotle, Herodotus, Livy and Hippocrates. Aristotle kills Descartes. Aristotle "Observing Bacon advance with a furious Mien, drew his Bow to the Head, and let fly his Arrow, which miss'd the valiant Modern, and

went hizzing over its Head; but Descartes it hit."[31] The young Charles Boyle and Temple were also successful slaying the moderns Bentley and Wotton. Interestingly, Newton is not mentioned in Swift's work, perhaps indicating that by 1704, date of publication of the *Tale* and the *Opticks*, Newton had failed to penetrate the consciousness of literary men. While Swift's satire of astronomers and mathematicians in book III of *Gulliver's travels* can be interpreted as anti-Newtonian, Swift is more critical of the world-making speculations of Whiston, the application of Newton's mathematical methods to the mechanical arts by men such as Desaguliers, along with the unreserved popularity of Newton's system among natural philosophers, than of Newton himself.[32] His criticisms are more directed at those around Newton than at his natural philosophy. Nor are there direct criticisms of Robert Boyle in Swift's works (a relation of Charles Boyle), a man who had a reputation as a pious and modest natural philosopher.[33]

Newton appears to have escaped the charges of vanity and immodesty levelled at many of his contemporaries. The most striking example of this can be found in the *Memoirs of the extraordinary life, works and discoveries of Martinus Scriblerus*, a collaborative satire of learning by Swift, Pope, Arbuthnot, Gay and Parnell. In the chapter relating to issues of natural philosophy, Martin is portrayed as a vain projector who pursues such projects as perpetual motion, the longitude and theories of the deluge. One of Martin's projects was particularly ridiculous; he had a plan to

> pierce the first crust or Nucleus of this our Earth, quite through, to the next concentrical Sphere: The advantage he propos'd from it was to find the Parallax of the Fixt Stars; but chiefly to refute Sir Isaac Newton's Theory of Gravity, and Mr. Halley's of the Variations.[34]

Here Tory satirists contrasted Newton with the modern enthusiast. In the midst of attacks on the vanity of many natural philosophers, Newton appears to have

emerged unscathed. This is at least partly due to the influence of Christ Church Newtonians such as Gregory, Keill and Freind. By illustrating how Newtonian natural philosophy had its roots in the ancient past, these men showed how Newton stood upon the shoulders of giants rather than seeking to surpass them. This was evidence of Newton's modesty in contrast to the vanity and spiritual pride of the moderns. Newton could be appropriated by the ancients just as easily as he could by the moderns.

Christ Church Newtonians and the usefulness of mathematical knowledge

Of the Newtonians at Oxford, John Keill took the most active role in defending the ancients. While John Freind's views were part of a collective Christ Church response to Bentley, and David Gregory refrained from any direct involvement in the controversy, Keill tenaciously criticised Bentley and Wotton, as he did Leibniz a decade later. In his *Examination of Dr. Burnet's theory of the earth together with some remarks on Mr. Whiston's new theory of the earth* (1698), Keill attacked both Bentley and Wotton. Keill rejected Wotton's claim in his *Reflections on ancient and modern learning* that Descartes was a great geometer who applied geometry to his natural philosophy: "This I think is a clearer demonstration than any in Des Cartes's principles of Philosophy, that Mr. Wotton either understands no Geometry, or else that he never read Descartes's principles."[35] Keill also opposed a statement of Bentley's in his *Confutation of atheism* that the moon always shows its same face to the earth. Keill wrote: "But it were to be wished, that great Criticks would confine their Labours to their Lexicons, and not venture to guess in those parts of Learning which are capable

of demonstration."[36] Apparently the publication of Keill's *Examination* was delayed because of its attacks on Bentley. Writing to Gough in 1696 Smalridge indicated that publication of the work was delayed "because notice was taken in it of an astronomical mistake of Dr. Bentley's" but that it later came out on "its being approved by our Mathematical Professors."[37] In the ancients-moderns controversy politics was always present. An attack on the Whig Bentley could be seen as indicative of disaffection with the regime of William and Mary.

Although Keill was not initially a member of Christ Church, having been incorporated at Baillol in 1694 and only transferring in 1703 upon the expiration of his Scottish exhibition, Wotton clearly identified him as one of his opponents. In the third edition of his *Reflections upon ancient and modern learning* (1705), Wotton added the essay, "A defence of the reflections upon ancient and modern learning." This essay began by responding to John Keill's criticisms of Bentley and himself. In relation to his statements about Descartes and Keill's ridicule of them, he declared: "since Mr. Keill sets up for Skill in those Parts of Learning particularly whose Increases in this Age I chiefly contend for, I thought I might reasonably have look'd for a fairer Quarter; and I could not forbear crying out, *Et tu Brute*, when he fell upon me."[38] Here Wotton expresses a sense of betrayal that a teacher of natural philosophy at Oxford (Keill had been made deputy to Thomas Millington, Sedleian professor of natural philosophy in 1699, and later gave lectures at Hart Hall) was siding with the ancients along with other literary men. He further complained that Keill's friend George Cheyne had copied his *Philosophical principles of religion* (1705) from Bentley's Boyle lectures and that Keill would approve this book because Dr. Friend recommended it.[39]

Oxford Newtonians like Keill not only attacked the moderns; they also promoted the usefulness of mathematical learning, supporting the ancient party's view that knowledge was valuable only insofar as it was useful. Just a year after Gregory became a member of Christ Church, the anonymously authored tract – *An essay on the usefulness of mathematical learning in a letter from a gentleman in the city to his friend in Oxford* (1701) – was published. This treatise has been attributed to both Arbuthnot and Keill.[40] Although Arbuthnot was a member of University College and Keill was initially from Baillol, both were closely connected to Gregory who was patronized by Henry Aldrich. The contents of the letter appealed to a Christ Church audience. Arbuthnot and Keill argued that mathematical learning was valuable because such studies could be applied to practical use. Mathematics was useful in the study of optics, medicine, and hydrostatics as well as navigation, fortification, ballistics, chronology and geography. The authors urged the establishment of mathematical lectures to educate merchants, seamen, surveyors, engineers and artisans.

But they also promoted mathematics teaching among gentlemen at Oxford. Practical mathematics had a long tradition in the education of young aristocrats.[41] These studies suited future men of public affairs, the statesman or military officer. Christ Church wits and their supporters applauded it in contrast to more speculative sciences. One can recall Swift's praise for the useful mathematics of Lilliputian engineers instead of the airy mathematical astronomy of the Laputians. In addition, Arbuthnot and Keill praised mathematics for its ability to train the mind to reason properly. Reasoning like all skills was acquired through practise:

> We are contrived by nature to learn by imitation more than precept; and I believe in that respect reasoning is much like other inferior arts (as dancing,

> singing) acquired by practise. By accustoming ourselves to reason closely about quantity, we acquire a habit of doing so in other things.[42]

Here Arbuthnot and Keill promoted the virtues of learning through imitation just as Christ Church literary men urged the imitation of the literary style of classical authors.

David Gregory was also a champion of practical mathematics. While a professor at Edinburgh, he had emphasized the many practical uses of mathematics.[43] This continued at Oxford in the early eighteenth century. Although he was not involved in public disputes with Bentley or Wotton, he was active in publishing the works of ancient mathematicians such as Euclid and Apollonius during this period and was particularly eager to emphasize the practical uses of geometry. His memoranda of his Oxford days contain many references to books of navigation, fortification and gunnery.[44] For Gregory astronomy and the arts of navigation and trade were closely intertwined. In an interesting statement on the writing of the history of astronomy he noted that

> Astronomy at first was cultivate chiefly for the sake of Navigation, and this for the sake of Trade: (Thus Atlas, who is reckoned the father and author of Astronomy, has this character given of him by Homer, that he knew the depth of all the parts of the Sea). So that its rise and fall must have been like the rise and fall of Trade; and its History cannot be made without knowing that of Trade and Commerce.[45]

After he moved from Baillol to Christ Church in 1700, Gregory put forward a detailed method for teaching mathematics and related subjects at Oxford. He proposed a course for interested scholars. The course would include the study of Euclid's *Elements*, plain geometry and practical geometry, algebra, mechanics, optics, the principles of astronomy and the theory of the tides. Other topics that might be included were fortifications, ballistics, projectiles, pendulums (timekeeping) and navigation.[46] The great merit of mathematics was its

usefulness and Gregory no less than Keill and Arbuthnot promoted its practical application.

Defenders of the ancients ridiculed natural philosophy that had little or no practical use. In particular natural history and geology with its close links to archaeology, philology and modern criticism were mocked. John Woodward who combined studies of natural history and fossil collecting with archaeological studies was a frequent target of satire. Beginning with Arbuthnot's criticisms of Woodward's *Natural history of the earth* (1695) and continuing through to Woodward's dispute with Freind over the proper method of treating the small-pox, Christ Church literary men and their supporters poked fun at Woodward.[47] He was sarcastically labelled as Dr. Fossil in Pope, Gay and Arbuthnot's *Three hours after marriage* (1717). William King's *Transactioneer* (1700) also complained about the fossil collecting of virtuosi. King stated in the satire that the Royal Society was in decline; due to the poor management of the *Philosophical transactions* by Hans Sloane its pages were now filled more with trivial curiosities such as fossils and monstrous births than with useful knowledge. In the preface to the work King stated that he was motivated to write the work "by the respect I have for Natural Studies, and a fear least those men who have made such great advances in it, and thereby gained the applause of all the learned world should lose any part of it by the trifling and shallow management of one [Sloane] who wants every qualification that is requisite for such a post."[48] King's claim that he was not an opponent of natural studies is significant. Natural philosophy was only criticised by the Christ Church wits and their defenders when its practitioners descended into useless trivial studies. By contrast, mathematics, with its many practical uses, was widely studied at Christ

Church, and Newtonian natural philosophy – a mathematical natural philosophy – found a home at the college. This is not to say that mathematical astronomers were immune from such attacks; one need only recall Swift's satire of the Laputians. But such an explanation goes someway toward explaining the strength of the physical sciences at Christ Church and the college's satires of fossil collecting virtuosi.

Newton and the revival of ancient knowledge: astronomy

Although Newton was a Whig like Bentley and Wotton he did not view his natural philosophy as representing a radical break with the past. He believed in the whole notion of a ***prisca sapienta***, an ancient wisdom. According to him, the Copernican system and his own principle of universal attraction were known to ancient Egyptian and Babylonian astronomers. This knowledge was subsequently lost and Europe held captive by the false philosophy of Aristotle and the Schoolmen. In Newton's case the corruption of natural philosophy was accompanied with the rise of priestcraft and polytheism or Trinitarianism. As Justian Champion has noted, freethinkers such as Charles Blount and John Toland used the concept of a pure primitive religion corrupted by Egyptian priests to attack priestly authority.[49] Newton conveyed his views on the ancient roots of astronomy to Gregory who probably communicated them to Keill. Whether he also conveyed to the Scot his opinions on the corruption of primitive Christianity, to a man who, as I have suggested in the previous chapter, had heterodox religious tendencies -- is unclear. However, the uses of history were various. As I will argue, political and religious conservatives could and did use

the wisdom of the ancients to defend traditional learning against the moderns. Indeed, Gregory's and Keill's belief that Newtonian natural philosophy represented a revival of ancient knowledge was only partly due to Newton's promotion of such an idea; it was also the result of the popularity of these ideas among defenders of the ancients in the ancients-moderns controversy. First I will highlight the influence of Newton on Gregory and Keill; then I will show how their ideas fit into ancients-moderns debate.

Central to Newton's history was the claim that after the flood Noah and his immediate descendants had true knowledge of religion and nature, knowledge that was eventually corrupted by the worship of false idols. When people lived in Chaldea under the government of Noah, knowledge of the heavens was perfect. In manuscripts like "The original of religions" and "Theologiae gentilis origines philosophicae", Newton claimed that the Copernican heliocentric system was known to the ancients. Indeed, "at the heart of Newton's belief in a pristine Noahian religion lies the symbol of the Temple – the eternal flame or a sacrificial altar at the center of a geometrically precise representation of the heliocentric solar system."[50] In the Prytanea or Vestal temples the true religion and astronomy was practised. This knowledge was communicated to the Egyptians whose priests also designed their temples around a central hearth or fire. However, the true religion of Noah was eventually corrupted by the worship of false Gods – by the attribution of spirits to the stars and planets.[51] Newton was committed to the Renaissance intellectual tradition that sought the rediscovery of an ancient pristine knowledge.

Newton's manuscripts reveal an interest in proving that the Newtonian cosmos was known in the past. In their famous article over thirty years ago J.E. McGuire

and P.M. Rattansi demonstrated how Newton, in several draft scholia intended for a revised second edition of the *Principia*, attempted to prove ancient knowledge of the atomic structure of matter, void space, universal gravitation, the inverse square law, and the divine cause of gravity.[52] In particular Newton used the authority of Democritus, Epicurus and Lucretius for ancient support of atoms and a vacuum, Pythagoras for past knowledge of the inverse square law and Thales and the Stoics for evidence of the spiritual or divine source of gravity. For Newton, Thales and Pythagoras were of great importance. They had travelled to Egypt and Babylonia, studied mathematics and brought back valuable knowledge to Greece. Newton hoped to trace ancient wisdom back to Moses in Egypt. The story of Hermes Trismegistus -- a mythical figure thought to be a contemporary of Moses -- who possessed true divine knowledge had much appeal to Newton and many of his contemporaries.[53]

As previously mentioned, many of Newton's ideas on a ***prisca sapienta*** were communicated to David Gregory in a meeting between the two men in May 1694. Indeed, the above draft scholia were given to Gregory at this time. Gregory's "Annotations physical mathematical and theological from Newton 5,6,7 May 1694" reveal that Gregory was aware of Newton's theories of the corruption of Noahian religion and a ***prisca sapienta***. Gregory noted that Newton "will spread himself in exhibiting the agreement of this philosophy with that of the Ancients and principally with that of Thales. The philosophy of Epicurus and Lucretius is true and old, but was wrongly interpreted by the ancients as atheism."[54] A few months later writing about the changes that Newton proposed to make to a second edition of the *Principia*, Gregory indicated that by

> far the greatest changes will be made to Book III. He will make a big change in Hypothesis III page 402. He will show that the most ancient philosophy is

> in agreement with this hypothesis of his as much because the Egyptians and others taught the Copernican system, as he shows from their religion and hieroglyphics and images of the Gods, as because Plato and others – Plutarch and Galileo refer to it – observed the gravitation of all bodies towards all.[55]

When Gregory published his *Astronomia physicae et gemetricae elementa* in 1702 his private discussions with Newton were uppermost in his mind.

In Gregory's preface to the *Astronomia* Newton's views about ancient wisdom are manifest. Regarding the draft scholia that Newton gave to Gregory, McGuire's and Rattansi's assertion that "Gregory drew from it extensively for the preface to his *Astronomia*, some paragraphs being almost identical with the manuscript," is accurate.[56] Gregory stated at the beginning of his preface that in order that "none may think the Physics deliver'd in the following Work intirely new and unknown in Astronomy, I shall take the liberty to shew that it was both known and diligently cultivated by the most ancient Philosophers."[57] He further stated "we do still tread in the steps of the Ancients in this Physical Astronomy; inasmuch as they knew that the Celestial Bodies gravitated towards each other, and were retain'd in their Orbits by the force of Gravity; and were also apprised of the Law of this Gravity."[58] In the preface Thales, Pythagoras, Anaximander and Anaximenes were praised for their belief in a heliocentric universe, the ancient atomists Democritus, Epicurius and Lucretius claimed to have derived their conception of universal gravity from their belief in an infinite universe, and Pythagoras said to have had knowledge of the inverse square law of attraction from experiments on the tensions of the strings of musical instruments. From the preface it is clear that the wisdom of the ancients was an important resource for Gregory to defend modern astronomy.

His student John Keill also believed the roots of astronomy lay in the distant past. In the *Essay on the usefulness of mathematical learning* published at

approximately the same time that Gregory was composing his work, the anonymous authors (Keill and Arbuthnot) declared that certain great ancients had established astronomy. In particular, "we cannot but admire its first inventors; as Thales Milesius, who, as Diogenes Laetius and Pliny say, first predicted eclipses; and his scholar Anaximander Milesius." It is to the Pythagoreans that we owe the true system of the universe "though it may be they were assisted by the Egyptians and Chaldeans."[59] Keill's last major publication, his *An introduction to the true astronomy* (1721) contained an even stronger case for the importance of African and Asian nations. The preface of this work provided a brief history of astronomy both ancient and modern. According to Keill, it was the ancient Egyptian and Babylonians who transmitted knowledge to the Greeks. Thales and Pythagoras were the best Greek philosophers because they had studied in Egypt.

> So Pythagoras who liv'd in Society with the Egyptians Priests seven years, and was initiated into their Religion, carried home from thence, besides several Geometrical Inventions, the true System of the Universe; and was the first that taught in Greece, that the Earth and Planets turn'd round the Sun, which was immovable in the Center.[60]

However, astronomy gradually declined due to the influence of Aristotle and the Schoolmen.

Additional evidence of Keill's interest in a ***prisca sapienta*** exists. In the Lucasian Papers of the Cambridge University Library is a draft of Keill's inaugural lecture as Savilian Professor of Astronomy. Most of Keill's manuscripts are in the Lucasian Papers, ironic considering Keill was a professor at Oxford. The majority of the manuscripts are on technical subjects, drafts of his lectures on astronomy and natural philosophy. But his inaugural lecture of early 1713 was of quite a different nature. Apparently it attracted the attention of Thomas Hearne. For his diary entry on February 5, 1713 Hearne noted: "this

Morning at eight a Clock Mr. John Keil read his Inaugural Lecture in Astronomy, he being made Savilian Professor. In it he spoke of ye Praise of Astronomy, and mentioned some of ye chief Discoveries, & also said somewt of the chief Promoters of Astronomy, ancient and modern."[61] In the lecture Keill examined the ancient origins of philosophy. The manuscript provides fascinating evidence of his belief in a ***prisca sapienta***.

Unfortunately it is incomplete and does not include Keill's comments on modern (Newtonian) astronomy.[62] The beginning section of the lecture illustrates Keill's belief in a cyclical view of history. In Keill's view knowledge did not perpetually increase but was subject to fluctuations. Philosophy is "not unlike that moon which it contemplates, has to itself its own special periods, and its own phases also, according to which it increases and decreases." Modern knowledge was simply a revival of ancient learning. Philosophy at one time "shone with much light; in later centuries maimed and halt and covered in clouds of words it was scarcely visible; in our age again it gleams with a fuller orb than any other time, destined to withdraw itself again from our eyes unless you, academicians, with your outstanding abilities and your diligence come to its aid.[63] After the corruption of natural philosophy by Aristotle and the Schoolmen, knowledge had been revived by Newton. Keill's fears about the future degeneration of knowledge might reflect his concern that Leibniz would become the dominant court philosopher upon the death of Queen Anne and the Hanoverian Succession. Indeed, in the period before his appointment as Savilian Professor at Oxford, Keill was the main defender of Newton in the calculus dispute with the German philosopher.[64]

In his lecture, as it exists in the manuscript, Keill contended that the ancient nations of the orient (especially Egypt) possessed true knowledge of the cosmos before the Greeks. If one went back to Moses in ancient Egypt one could find true philosophy;

> from reliable monuments it is agreed that philosophy flourished around the time of Moses or even in the times of Joseph among the Egyptians; nor are there lacking reasons which suggest that Joseph was that ancient and celebrated Hermes of the Egyptians, the inventor of arithmetic, geometry, astronomy and other arts. Certainly in the next century among the colleges of priests letters were vigorous, philosophy flourished, nor were those priests students of magical incantations or illicit arts, but instructed both themselves and others in learning of every kind.[65]

In this passage Keill revealed his belief in the existence of Hermes Trismegistus, that mythical contemporary of Moses who possessed divine knowledge. It was from the Egyptians that Greeks like Thales and Pythagoras gained their knowledge of astronomy and geometry

> It was customary for the first Greek philosophers to wander through all the regions of the Orient, to converse with Babylonian astrologers, Persian magi, the priests of Egypt and the Brahmans of India, and to bring back their disciplines. Concerning which matter Diodorus writes thus: the priests of Egypt confirm by the authority of their sacred books that to their people at some time came Orpheus, Museus, Melampus and Daedalus, and also the poet Homer, Lycurgus the Spartiate, Solon the Athenian, Plato the philosopher, Pythagoras of Samos, Eudoxus the mathematician, Democritus the Abderite and Oenopidas of Chius.[66]

Keill also praised the ancient philosophers of Africa and Asia for their knowledge of medicine, chemistry and pharmacology. Like Newton and Gregory, Keill expressed his belief in the Egyptian origins of a ***prisca sapienta*** and the importance of Thales and Pythagoras in the transmission of Egyptian thought to Greece.

Yet Gregory's and Keill's belief that modern astronomy had its roots in the ancient past was not only the product of Newton's teaching. The manner in which both men promoted early eighteenth century astronomy by an appeal to

ancient authority was also greatly influenced by their position as leading intellectuals at Christ Church. Promoters of the ancients defended ancient natural philosophers as well as the literary excellence of past Latin and Greek poets. I will argue that the above writings of Gregory and Keill can be viewed as a contribution of Christ Church natural philosophers to the debate, an important contribution since, with the exception of John Freind, the Christ Church wits were not natural philosophers but literary men. The debates about the relative merits of ancient natural philosophers were integral to the controversy.

William Temple and William Wotton, the two men who began the battle, had different views on this matter. In his "Essay upon the ancient and modern learning," (1692) Temple echoed views similar to those of Keill twenty years later. He stated

> Tis evident, Thales and Pythagoras were the Two Founders of the Grecian Philosophy; the First gave Beginning to the Ionick Sect, and the other to the Italick; out of which, all the others celebrated in Greece or Rome were derived or composed: Thales was the First of the Sophi, or Wise Men famous in Greece, and is said to have learned his Astronomy, Geometry, Astrology, Theology, in his Travels from his Country Miletus to Egypt, Phoenicia, Crete and Delphos: Pythagoras was the Father of Philosophers, and of the Virtues, having in Modesty chosen the name of a Lover of Wisdom.[67]

Egyptian knowledge, the inspiration behind the learning of Greece and Rome, had been obtained through commerce with Ethiopians, Chaldeans, Arabians and Indians. Temple believed that the Brahmins of India had personally educated Pythagoras. In contrast, Wotton vigorously disagreed arguing that the wisdom of Thales and Pythagoras had been greatly exaggerated and that ancient Egyptians and Chaldeans had only limited knowledge of mathematics and astronomy. An appeal to the wisdom of the philosophers of the Orient was as much a part of a defence of the ancients as writing in favour of the Epistles of Phalaris.

The composition of Gregory's preface and Keill's inaugural lecture cannot be divorced from their local contexts. Gregory's preface to his *Astronomiae* was written shortly after the Christ Church wits collectively responded to Bentley and Wotton and at approximately the time when *An essay on the usefulness of mathematical learning* was published, a work that defended learning through imitation. As previously mentioned, after Gregory joined Christ Church he was active in publishing the works of ancient mathematicians, editing a collection of the works of Euclid and undertaking, with Edmund Halley, a joint edition of Apollonius, a project he did not complete due to his death in 1708. Gregory received support for these projects from the then Dean of Christ Church Henry Aldrich. Hearne noted that Aldrich was instrumental in the publication of Gregory's Euclid.[68] Given the help that Aldrich gave to both Keill and Gregory, it is not surprising that the latter would be anxious to emphasize in his preface to his *Astronomiae* how natural philosophers still walked in the footsteps of the ancients.

The timing of Keill's inaugural lecture and his appointment to the Savilian chair is also significant, as it reflects the changing fortunes of Tories at Oxford. His position as Savilian professor of astronomy was much coveted and viewed as an important source of patronage. When Gregory died in 1708 Keill was thought a likely successor. However, party politics played a role in the choice of a new professor. As Swift wrote to Robert Hunter: "you know, I believe, that poor Dr. Gregory is dead, and Keil sollicites to be his Successor. But Party reaches even to Lines and Circles, and he will hardly carry it being reputed a Tory, wch yet he wholly denies."[69] Keill's denial of his Tory High-Church background in 1708 may have been due to the strong position of the Whigs in British politics. The

influence of Malborough and Godolphin was then strong at the court leading to few valuable university appointments for Oxford Tories. For example, when the reguis professorship of divinity became vacant in 1707, it was Malborough's favourite John Potter, chaplain to Archbishop Tension, who was selected and not Christ Church's candidate George Smalridge.[70] Similarly, Gregory's replacement was not Keill but John Caswell whom Hearne described as "an Hippish Man and of Low Church as to Principles."[71]

After failing in his bid for the Savilian Professorship, Keill courted the patronage of Tories and High-Churchmen both inside and outside of Oxford. In 1709 Robert Harley appointed Keill treasurer for the refugees from the Palatinate, in which capacity he travelled to New England that year.[72] When he returned two years later the Tories were dominant at court and Atterbury had replaced Aldrich as dean of Christ Church. Keill's High-Church and Christ Church connections made him a likely candidate to replace Caswell. Christ Church, with its large number of votes in university convocation, was able to exercise considerable influence in elections to university offices, and with Atterbury playing an important role in the new Tory government, Keill's persistence was rewarded with his appointment to the Savilian chair in 1712. The close relationship between Atterbury and Keill's selection is suggested by the discovery of Smalridge's "A speech on the election of a prolocutor" amongst the same papers as Keill's inaugural lecture, a speech Smalridge gave upon the election of Atterbury as prolocutor or leader of the lower house of Anglican convocation in 1710.[73] It is probable then that Keill's inaugural lecture was written to suit a Tory High-Church audience.

The extent to which Christ Church Newtonians talked to their literary colleagues about Newton and Newtonian natural philosophy has been largely unexplored. But it does appear that Atterbury and possibly other of his literary colleagues held the notion that Newtonian natural philosophy represented a revival of ancient knowledge, a view likely influenced by Gregory and Keill. Writing to his French correspondent Nicholas-Claude Thierot after Newton's death in 1727, Atterbury commented on Fontenelle's eulogy of Newton revealing in the process his knowledge of Newton's belief in an ancient wisdom.

> M. Fontenelle's praise of Sir Isaac's modesty (and of modesty in general) is to me the most pleasing part of that description he has given us of him. It is that modesty which will teach us to speak and think of the Ancients with reverence, especially if we happen not to be thoroughly acquainted with them. Sir Isaac certainly was, and his great veneration for them was one distinguishing part of his character, which I wonder (or rather do not wonder) that M. Fontenelle has omitted. His opinion of them was, that they were men of great genius and superior minds, who had carried their discoveries (particularly in Astronomy and other parts of the Mathematicks) much farther than now appears from what remains of their writings.[74]

The image of Newton that Atterbury presents here is very different from the vain modern found in Swift's *Tale of the tub*. Newton is an acceptable natural philosopher because he is modest and does not seek to overthrow the traditional authority of the ancients. Although Atterbury may have attended Keill's inaugural lecture, it seems likely that Gregory or Keill communicated to him and others Sir Isaac's great veneration for the ancients. Christ Church's desire to defend ancient knowledge combined with Newton's own belief in a ***prisca sapienta*** to make Newton a respectable figure at the college.

Although Newton was a Whig and a secret anti-Trinitarian whose heretical views were promoted by his disciples Whiston and Clarke, Christ Church defenders of the ancients sought to claim Newton as one of their own. He was a key token for them in current controversy. Newton's reputation was too large to

attack. To be able to claim Newton from the moderns was an astute tactic, and a heavy ideological blow if successful. Defenders of ancient learning used Newton's belief in a restoration of lost knowledge to advance Tory High-Anglicanism just as Newton's heterodox followers used Newton's anti-Trinitarianism to promote their own non-conformist views. This explains the general lack of direct references to Newton in the satires of the Scriblerians. Indeed, when John Conduitt asked for Pope's help with writing a dedication to Newton's posthumously published *Chronology of ancient kingdoms amended* (1728), Pope wrote to him that a history of Newton "would make as Great a Discovery of Virtue and Goodness and Rectitude of Heart, as his Works have done of Penetration and the utmost Stretch of Human knowledge."[75]

Newton and the revival of ancient knowledge: medicine

While Gregory's and Keill's studies of the ancients were almost solely related to their interest in natural philosophy, John Freind was an accomplished classicist – a member of the Christ Church literary wits who responded collectively to Bentley and Wotton. Educated at Westminster School and matriculating at Christ Church in 1694, he attracted the notice of Dean Aldrich who appointed him editor of a Greek and Latin edition of the orations of Aeschines and Demosthenes. Freind became a close acquaintance of Atterbury and was deeply implicated in Atterbury's plot for the restoration of the Stuart monarchy in 1722-23. At Christ Church Freind was a fervent supporter of the new mathematical medicine promoted by Pitcairne in Scotland and fellow Scots at his college. Like Gregory's and Keill's views on the ancient origins of modern astronomy, Freind

believed that Newtonian medicine had its roots in the past. The type of physic advanced by Pitcairne was part of a learned tradition that was being restored. Such reverence for ancient learned medical authority served as a useful antidote to battle medical, political and religious freethinking.[76]

Freind urged the importance of the study of ancient medical authors in his bulky *The history of physick from the time of Galen to the beginning of the sixteenth century*. Written only a few years before his death in 1728 the *History* is a two-volume study of the rise and fall of physic from its apogee during the time of the ancient Greeks through periods of intellectual stagnation in the middle-ages to its eventual resurgence in the late fifteenth century. Only in this later period did the writings of the Greeks begin to be seriously studied and correctly interpreted.

In the *History* Freind affirmed that after 600 A.D. medicine had declined. Physic made progress during the time of Hippocrates, Galen and succeeding Greek physicians like Oribasius, Aetius, Alexander and Paulus. However, those that followed were of a lower calibre: "And if the later Greek writers, who succeeded, were persons of a lower character, and made little advancement in the Art they professed, it is the less to be wonder'd at, since for many centuries universal ignorance prevailed over all the world."[77] Much medical knowledge of ancient Greece was preserved by the Arab world. Indeed, a substantial portion of Freind's *History* is devoted to the study of Arab physicians like Mesue, Rhazes, Avicenna, Avenzoar and Albucasis. Yet "Arabian learning, however magnified by their own nation and by some European moderns, was intirely deriv'd and borrow'd from the Greeks: and this race of men was so far from making great improvements in any science, that whatever they translated or imitated was rather

made worse."[78] Following the example of the Arabs, European doctors in the middle-ages

> were for the most part either professors or commentators, few gave themselves the trouble to go out of the beaten road, and were contented with that stock of knowledge, which they found chiefly in the Arabian authors: their only study almost an emulation seems to have been, to quote and adapt passages out of them to their own purpose.[79]

Freind portrays Europe before the fifteenth century as living in a period of intellectual darkness.

The resurgence of medicine began during the Renaissance of the late fifteenth century. In the concluding portions of his *History* Freind praised the recent discoveries in anatomy made by Vesalius and later Columbus, Eustachius and Fallopius. Harvey was applauded for his discovery the circulation of the blood. However, Freind was critical of many modern anatomists for "advancing every trifling discovery into an Hypothesis. Hence those idle dreams about the Nervous, the Pancreatick Juice, the Bile and the Spittle."[80] Modern system-makers such as Aristotelian schoolmen, Cartesians and chemical philosophers invented imaginary hypotheses to explain medical and other phenomena: "Wou'd any one go so much out of the way, as to account for the motions of a Watch from the precarious doctrine of Acid and Alkali? or wou'd he make use of the Aetheral matter of Descartes, to solve all the appearances of Hydrostaticks?"[81] Freind declared himself in favour of a physic based on the mechanical philosophy, specifically that promoted by the Newtonian Pitcairne. Such a medicine in his opinion was in accordance with the medicine of ancients like Hippocrates.

Freind's analysis of medicine during the seventeenth century was limited; the *History* was only designed to cover the history of medicine until the sixteenth

century, and it is in his earlier work *Emmenologia* that his defence of Newtonian mathematical medicine and its ancient roots is more apparent. Written in 1703 the *Emmenologia* is a treatise on female menstruation. Freind concluded that menstruation was the product of a plethora of blood resulting from the relative lack of perspiration in women in comparison to men. Perspiration and blood flow was subject to mathematical analysis in accordance to the laws of mechanics. Following Pitcairne and other Scottish Newtonians, Freind believed that physic could be reduced to geometrical rules. Indeed, "whoever is so conversant in Staticks and Anatomy, as to be intimately acquainted with the human Body, and thoroughly knows the Nature and Powers of the circulating Fluid, will easily discern which is the true Indication of the Disease, and what Method of Cure ought chiefly to be pursued."[82] This approach to medicine found support in the writings of Hippocrates. Freind noted that Hippocrates recommended to his son Thessalus

> who applied himself to the Study of Physick, the knowledge of Numbers, and the properties of Figures; and to take much pains in that Science, which teaches them, and measures any Magnitudes whatever. For he allows them to be the only Springs, whence the true knowledge of physical Matters can flow. And it is indeed very credible that these Elements, which he so vehemently exhorts his Son to learn, were perfectly known to himself. For he was a Pupil and Follower, as we read, of Democritus; who, at that time, taught that Philosophy, which is at present called the Mechanick, and which is so far from being Modern, as it is commonly thought, that it is the most Ancient of all.[83]

The appeal to the authority of Hippocrates in this instance appears misguided given the relative lack of mathematics in the Hippocratic corpus. As noted in chapter two, Pitcairne's disciple George Hepburn had classified the medical theories of Hippocrates and Galen with the sectarian physic of the chemists and Cartesians. When Pitcairne did appeal to ancient authority it was usually to mathematical natural philosophers like Archimedes. Freind's desire to link the

new physic with Hippocrates is very much part of his desire to defend ancient medical authority and is also likely due to his greater concern with issues of medical practise.

Freind believed Newtonian medical theory was useful to battle the physic of unlearned empirics. As there was a natural hierarchy in society so too was there hierarchy in medicine with university-educated physicians at the top. The latter were instructed in the rational part of physic. Like Cheyne, Freind concluded that doctors who understood the causes or theories of disease made much better practitioners. Indeed, "we confess…..that this Theory [of the menses], which we are pleading for, is of little service in Physick, unless also it be added to frequent practise; which, yet if it be directed by this guide, will be less liable to those Mistakes, which are otherwise guarded against in vain."[84] In his *History* Freind claimed that modern anatomists who are contended with only a bare description of things are "like some workers in Mechanicks, who understand the figure and position of every Wheel and Spring of the Machine, but are ignorant of the true reason of its movements."[85] As with Pitcairne and his supporters in Scotland, there was a social component to Freind's opposition to the moderns, an imputation of vulgarity or populism to modern physicians who based their physic on Sydenham's empirical methods or on the false novel theories of the Cartesians. Those who did not base their medicine on theory firmed rooted in the ancient past were viewed as vain quacks and enthusiasts who had mistakenly rejected medical instruction in traditional institutions of higher learning.

For Freind it was essential that the physician base his theories upon the established texts of the ancients; those who deviated from this path were proud freethinkers. Medicine was not based solely on experience, but through a close

study of ancient authors as well. As Freind declared, every "physician will make, and ought to make observations; but he will be able to make a better judgement and juster observations, by comparing what he reads and sees together."[86] It was upon good grounds that Hippocrates and Galen have been esteemed the fathers of medicine. Those medical men who ignored the ancients and based their physic on knowledge gained from modern speculative systems were on the wrong track. Empirics and disciples of moderns like Descartes and Paracelsus failed to acknowledge the value of the ancients. Linking vain moderns with religious nonconformity, Freind stated it is "arrogance peculiar to some of our age and nation, to despise the most learned and celebrated Writers in their own Profession: and the darling notion of free-thinking carried beyond its bounds, has done a great deal of mischief in Physick, as well as divinity."[87] In contrast Newtonian medicine was not new but part of a continuous learned tradition. Those who completely rejected ancient wisdom were plagued by the same vanity as the heretics of Freind's age.

Newtonianism and the modest natural philosopher

Modesty was an important attribute of a natural philosopher in early modern England. Steven Shapin has shown how the idea of modesty in natural philosophical discourse was intimately wrapped up with codes of gentlemanly conduct.[88] The political and religious battles between Whig and Tory and Low-Churchmen and High-Churchmen in the early eighteenth century witnessed attempts by Tories High-Churchmen to portray their opponents as vain corrupt men who foolishly used their reason to understand and to question religious

mystery. It has already been noted how Tory satirists portrayed the moderns led by the Whigs Bentley and Wotton as men puffed up with spirit who overestimated their own ability. High-Church Tories feared that biblical revelation was under threat from reason and often stressed in scholarly works the limits to human knowledge. A typical example of this is the Cambridge non-juror's Thomas Baker's *Reflections upon learning* (1699) that went through numerous editions. Baker stated that "Reason is a proper Guide in our Enquiries, and is to be follow'd, where it keeps within its Sphere; but shining dimly, it must borrow Rays from the Fountain of Light, and must always act subordinately to Revelation."[89] In this section of the chapter, I will argue that Newton was not only viewed as a modest natural philosopher because of his respect for the ancients but also because of his methodology.

Newton's method could justify this view of him in various ways. As chapter two indicated, in the 1690s Newtonianism meant the mathematical natural philosophy of the *Principia*. The *Principia* sought to demonstrate the laws by which nature operated mathematically but did not enter into speculations about the causes of phenomena. In the preface to the first 1687 edition, Newton suggested that "all phenomena may depend on certain forces by which the particles of bodies, by causes not yet known, either are impelled toward one another and cohere in regular figures, or are repelled from one another and recede," but added that "these forces are unknown."[90] Newton's *Opticks* hinted that such problems could be tackled through experimental philosophy. In the queries to the *Opticks*, especially those added to the 1706 Latin edition, Newton speculated that bodies might have certain powers or forces by which they act at a distance and introduced his nut-shell theory of matter. These principles, Newton

declared, "I consider, not as occult Qualities, supposed to result from the specific Forms of things, but as general laws of nature, by which the Things themselves are form'd; their Truth appearing to us by Phaenomena, though their causes be not yet discovered."[91] Newton expressed similar sentiments in the General Scholium of the *Principia* (1713) where he stated that gravity was due to a subtle spirit pervading gross bodies, adding that "there is not sufficient number of experiments to determine and demonstrate accurately the laws governing the actions of this spirit."[92] Newton's unwillingness to make strong assertions about the nature of matter and of attractive powers and his decision to pose such problems in the form of queries were interpreted by some as evidence of his modesty.

This was the opinion of Keill and Freind. After the publication of the Latin edition of the *Optice*, both natural philosophers were quick to publish their own writings on attractive powers and matter theory. Keill's paper "Epistola… in qua leges attractionis, aliaque physics principia traduntur" appeared in the *Philosophical transactions* of 1708. This paper discussed the hierarchical structure of matter and defended a vacuum in nature and attractive powers. Keill asserted that the idea of attractive powers was drawn from experience: "that matter is endued with an attractive force, by which its particles mutually attract each other, Sir Isaac Newton first deduced from the phenomena."[93] Freind's *Praelectiones chymiae* or *Chemical lectures* based on his chemistry lectures at the Ashmolean Museum in 1704 also concluded that the principle of attraction is not "bare Speculation, but taken from the very Nature of Things, and the Propension of Bodies."[94] Freind attacked Cartesian ideas as mere hypotheses or figments of the imagination whereas Newton followed a different method:

> he assumes nothing but Observations and Experiments, which are evident to the Sense of all Mankind, and from thence he deduces demonstrative Conclusions, and then again, by the Assistances of these Conclusions, he Explains the Causes of many Phaenomena in Nature.[95]

While attraction might never be fully understood, our experience indicated that it did exist. Keill too believed inquiries into physical matters of this nature were less certain than geometrical demonstrations, but that did not mean powers or forces did not exist, only that we could not fully comprehend them. Experimental natural philosophy was certainly a superior alternative to the metaphysical speculations of other philosophers.

In contrast to Newtonian natural philosophy, the systems of such philosophers as Descartes, Leibniz and Spinoza seemed overly ambitious and highly speculative. While they sought to deduce a world system from reason, Newton's metaphysics and theology was grounded solely on his natural philosophy. As Newton stated in the General Scholium, "to treat of God from phenomena is certainly a part of natural philosophy."[96] The differences between Newton and a rational philosopher like Descartes were significant. The latter had claimed that "philosophy as a whole is like a tree, of which the roots are metaphysics, the trunk physics, and the branches emerging from this trunk all the other branches of knowledge." [97] From first principles Descartes and other rationalist philosophers believed they could construct a world system. For Newtonians like Keill, Arbuthnot and Freind such efforts were the product of overweening pride. Statements about the natural world based entirely on the intellect, on a person's subjective judgement, were interpreted as evidence of a natural philosopher's vanity, while the willingness to ground conclusions on proofs from nature that were externally verifiable was evidence of modesty. Commenting on Descartes, Keill stated that

> he has encouraged so very much this presumptious pride in the Philosophers that they think they understand all the works of Nature and are able to give a good account of them, whereas neither he, nor any of his followers, have given us a right explication of any one thing.[98]

Grounding natural philosophy on mathematics and experiment provided true knowledge of nature instead of the fables of speculative philosophers.

Even worse, the systems of Newton's opponents led to heresy. Newton and his supporters saw the existence of attractive powers in his universe as evidence of God's providence. On the eve of the publication of Newton's queries to the 1706 Latin *Optice*, David Gregory revealed Newton's belief that God was

> omnipresent in the literal sense; And that as we are sensible of Objects when their Images are brought home within the brain, so God must be sensible of every thing, being intimately present with every thing: for he supposes that as God is present in space where there is no body he is present in space where a body is also present. But if this way of proposing this his notion be too bold, he thinks of doing it thus. What cause did the ancients assign of Gravity. He reckoned God the cause of it.[99]

Newton believed matter was essentially passive and not active; the existence of active principles in his universe indicated that God continuously operated in void space, not that motion was inherent to matter. For Newton's followers his system functioned as a safeguard against Cartesian materialism and the pantheism of philosophers like Spinoza. By postulating a universe full of matter left to function according to the laws of mechanism, Descartes appeared to have taken God and the miraculous out of nature. On the other hand Spinoza had equated corporeal extended substance with God or, in other words, God with nature. Leibniz's system of monads that were active and the source of their own motion also suggested that nature and God were one.[100] Instead, the Newtonian universe offered a via media between a world where God was absent and one that reduced God to matter.

It is not surprising that Keill and Freind took an active part in the defence of Newton in the dispute with Leibniz. In an article written on the politics of the dispute, Steven Shapin has argued that court Whigs such as Samuel Clarke and Richard Bentley used Newtonian ideas to battle Leibniz, associating the latter's philosophy with the pantheistic republicanism of more radical Whigs like John Toland and Anthony Collins.[101] What Shapin's account fails to note is that John Keill initiated the calculus controversy between Newton and Leibniz, a dispute that was broadened to include issues of natural philosophy.[102] Given Keill's political and religious allegiances he would have been more alarmed than court Whigs about the possible ascendancy of Leibniz at the English court upon the Hanoverian Succession. In the last days of Queen Anne's reign, Tories feared their interests were in danger from the pro-Whiggish House of Hanover. Interestingly, Leibniz viewed the attacks on him as part of Tory onslaught against the House of Hanover. Writing to Bernoulli in 1713, Leibniz stated that

> your guess just about hits the nail on the head, that is, that those who have little love for the House of Hanover have also meant to wound me; for an English friend writes to me that it seems that some certain persons have acted not as mathematicians and Fellows of the Royal Society against a Fellow, but as Tories against a Whig.[103]

Leibniz was certainly uppermost in the mind of Keill after the death of Queen Anne. Writing to Newton only a few days after her death he declared, "I hope Mr. Leibnits after this will not have the impudence to show his face in England. if he does I am persuaded that he will find few friends."[104]

Freind also was involved in disputes with Leibniz. The Leibnizian journal *Acta eruditorum* criticised Freind's *Praelectiones chymicae* of 1709. In the second Latin edition published eight years later Freind added an appendix criticising this review. In the appendix Freind attacked Leibniz's *Dynamicum* for

concluding that motion or activity was essential to matter. Rejecting the notion that mechanism alone could explain motion, he stated it was through the laws of nature and the principle of attraction

> God Directs and Governs the Universe, and makes all the Parts of the material World move with exact Harmony and Order; tho' this very Principle, as well as the Frame and Constitution of Nature it self, owes its Being merely to his arbitrary Will and Pleasure. Whereas they who acknowledge no such Principle, but will have all the Operations of Nature to be Mechanical, not only as to their Immediate But Remotest Causes, so that every thing in their Opinion results from the Essence of Matter and the unalterable Laws of Motion, seem to take away the necessity of owning a Supreme Infinite Intelligent Being, who Directs and Rules the Universe; and by that means they furnish the Atheists With Arguments to defend and support their Impious Cause.[105]

While Leibniz and followers of Descartes may have dismissed the principle of attraction as spurious, it was a true and pious notion. Attempts to understand gravity through the use of reason had failed. Attraction was a mysterious concept that could only be comprehended by invoking God. As Thomas Baker noted "Gravitation was never yet solv'd, and possibly, never may, and after men have spent a thousand years longer in these Enquiries, they may perhaps sit down at last under Attraction, or may be content to resolve all into the Power or Providence of God."[106] The fact that Newton was willing to do exactly this was music to the ears of many High-Church divines.

Newton and world-making

Perhaps the best way to illustrate how Newton was seen as a pious natural philosopher, a suitable resource for Anglicans to appropriate in the defence of Christianity, is through a discussion of Newton's relationship to controversies surrounding world-making. World-making was mentioned by Atterbury as one of

the chief symptoms of England's social and religious decline after 1688. The late seventeenth century saw a notable increase in attempts to explain the earth's history via the mechanical principles of the new science.[107] Such attempts often conflicted with the Mosaic account of creation and threatened to reduce God's providential role in catastrophic events like the flood. World-making was an example to many Anglican divines of the abuse of reason – the use of natural philosophy to attempt to comprehend the incomprehensible. Past events like the creation and Noahian flood were mysterious. While Newton made his own speculations on these topics, he was hesitant to publicize these interests. Much like his anti-Trinitarianism, Newton's world-making was not for public consumption. This allowed Tory Newtonians like Keill to disassociate Newton from such theorizing. Newton was seen as one who did not seek to reduce all catastrophic change on earth to secondary causes, but instead was a defender of God's direct providence.

Of all the world-makers Thomas Burnet was the most controversial. His ambitious *Telluris theoria sacra* published in Latin in (1681/1689) and translated into English as *The theory of the earth* in (1684/1690) provoked much debate.[108] Burnet attempted to provide a mechanical explanation of the earth's history from the Garden of Eden till the final consummation of all things. According to Burnet, the earth before the flood was smooth, regular and uniform without mountains or a sea. The earth we now live on was the product of the Noahian flood when – due to the drying and cracking of the earth's crust – subterranean waters issued forth causing the flood and creating mountains, sea-channels, rocks, caves and islands. While Burnet thought both reason and scripture were valuable sources for understanding the earth's past, he declared that "Reason is to

be our first Guide."[109] Indeed, Burnet claimed in his *Archaelogiae philosophicae* (1692) that the Mosaic account of man's early history was not a true description of events on earth. Regarding Moses' six-day chronology for the creation and formation of the earth, Burnet asserted:

> Now these short Annotations upon the Account Moses gives us of the first Creation of Things, seems to imply that it was not this sacred Author's Design to represent the Beginning of the World, exactly according to the Physical Truth; (which would have been of no Use to the common People who were uncapable of being made Philosophers) but to expound the first Originals of Things after such a Method as might breed in the Minds of Men Piety, and a Worshipping of the true God.[110]

According to Burnet, scripture was a mere parable; it had some truths in it but was adapted to the capacities of the vulgar. Such challenges to the literal veracity of scripture shocked orthodox Anglicans.

In the 1690s there were other attempts to provide mechanical explanations for the early earth's history and for the end of the world. For example, John Woodward, the target of much ridicule from Tory satirists due to his fossil collecting activities, attempted to explain the distribution of sea-shells in various geological strata by providing a mechanical explanation for the flood. His *Essay toward a natural history of the earth and terrestrial bodies* (1695) asserted that the whole earth was taken to pieces and dissolved at the time of the flood:

> the Particles of Stone, Marble and all other solid Fossils dissevered, taken upon into the Water, and there sustained together with Sea-shells and other Animal and Vegetable Bodies: and that the present Earth consists, and was formed out of that promiscuous Mass of Sand, Earth, Shells and the rest; falling down again, and subsiding from the Water.[111]

After the receding of the waters the sea-shells descended according to their specific gravities and were embedded in the various geological strata now present.

A year after Woodward's book William Whiston published *A new theory of the earth*, a book that attempted, like Burnet's, to provide a mechanical account of the creation, flood and final consummation of all things through secondary causes. While Burnet was heavily influenced by Cartesian ideas and methods, Whiston based his *New theory of the earth* on a Newtonian understanding of the cosmos. In the Newtonian universe the movement of comets became subject to mathematical analysis. Their movements were no longer mysterious; they were predictable from the laws of nature. Whiston claimed the planets had formed out of the chaos of a comet and that a comet caused the flood by passing the earth. A comet would also cause the final conflagration. In contrast with Burnet, Whiston defended scripture against the charges that it was a mere parable. While the Mosaic account of creation did not provide a true philosophic account of the origin of all things, it represented a "Historical and True Representation of the formation of our single Earth out of a confused Chaos, and of the successive and visible changes thereof each day, till it became the habitation of Mankind as witnessed by a person on earth."[112]

Of the Newtonians at Christ Church John Keill was most vocal in opposition to world-making. In two works – *An examination of Dr. Burnet's theory of the earth together with some remarks on Mr. Whiston's new theory of the earth* (1698) and *An examination of the reflections on the theory of the earth together with a defense of the remarks on Mr. Whiston's new theory* (1699) – he attacked Burnet and Whiston. Keill traced the phenomena of world-making back to Descartes. Cartesians like Burnet had foolishly tried to explain the earth's history through the laws of mechanism. According to Keill, past events like the universal deluge were miraculous and evidence of God's power and he criticized both

Burnet's and Whiston's attempts to explain the deluge through secondary causes. In Keill's view "the Deluge was the immediate work of the Divine power, and that no secondary causes without the interposition of Omnipotence could have brought such an effect to pass."[113] The attempt to merge biblical history with the mechanical philosophy inevitably led to attacks on the historical veracity of scripture. In response to Burnet's and Whiston's claims that scripture did not provide a true philosophically accurate account of the earth's history, Keill asserted that "Moses's narration is plain and simple, and throughout the whole, he does not affect to speak either Metaphorically or Allegorically; but he delivers it as certain matter of fact, which we are firmly to believe."[114] Mechanical philosophers must be content with studying the common and ordinary appearances of nature and confess their ignorance of larger things.

The speculations of Burnet and Whiston were contrary to both scripture and the principles of natural philosophy – those founded "upon observations and calculations, both which are undoubtedly the most certain principles, that a Philosopher can build upon."[115] Whiston's claim that the earth was first a comet contradicted scripture's claim that the earth was originally "without form, and Void, and that Darkness was upon the face of the Deep."[116] A bright comet could not have been that original chaos out of which the earth was formed. Burnet's and Whiston's mechanical explanations for the flood were equally faulty. Keill questioned Burnet's claim that the hot climate of the earth would cause cracks on the earth's surface and waters from the abyss to issue forth; he also thought Whiston's hypothesis of a comet creating cracks in the earth's surface from its gravitational attraction and waters to arise from the abyss fictitious. Such speculations were contrary to true philosophy and to scripture.

Others Tories attacked world-making. In *An examination of Dr. Woodward's account of the deluge* (1697) Arbuthnot criticised Woodward's explanation of the flood. He complained that Woodward's account did not complement Moses' description in scripture:

> I wish the Compilers of Theories would have more regard to Moses' Relation, which surpasses all the accounts of Philosophers as much in Wisdom, as it doth in authority. The Doctor is not singular in this, it is but too common a Fault now a-days[117]

What disturbed Arbuthnot most about Woodward's work was the latter's assertion that his theory was proven with demonstrative certainty. Arbuthnot hoped that people in the future would be "more diligent in observing and more cautious in system-making."[118] At Cambridge the nonjurors Thomas Baker and Richard Marsh of St. Johns, also attacked world-makers. The latter expressed alarm that scripture was under threat from men like Burnet, Woodward and Whiston:

> The great Design of these Men [world-makers] is to give a Rational Account of the Mosaical Creation; and where the Sacred Writer is either silent, or goes off from Mechanical Rules, there the Philosopher steps in, to help him out in the matter; and rather than Mechanism must be broke, the Sacred Text must be rack'd into Confession of it.[119]

Like the modern fanatic of Swift's *Tale of the tub* the world-maker was puffed up with spirit and suffered from the disease of pride.

World-makers were easy targets for ridicule by Tory satirists. In chapter seventeen of the *Memoirs of the extraordinary life, works and discoveries of Martinus Scriblerus*, Martinus is criticized for his theories of the deluge and mechanical explanations of the formation of the universe according to the Epicurean Hypothesis.[120] The Laputans of book III of Swift's *Gulliver's travels* were mocked for their concerns about changes in the celestial bodies. They foolishly worried that "the earth very narrowly escaped a brush from the tail of

the last comet, which would have infallibly reduced it to ashes; and that the next, which they have calculated for one and thirty years hence, will probably destroy us."[121] Given the very public millenarianism of individuals like Whiston such criticisms are not surprising. After he was expelled from Cambridge in 1710 for publicizing his Arian views, Whiston embarked on a career of public lecturing. His speculations about the end of the world produced much fascination and laughter among the literary wits.[122]

For Keill, Arbuthnot and Tory literary men world-making was connected to the intellectual vanity of modern scholars. There was a strong association between the geological speculations of world-makers and the methods of the modern historical critic. As the world-maker used the evidence of fossils and geological formations to inquire about catastrophic changes in the earth's past, the modern historian used evidence from archaeological digs to reconstruct history. Keill's attacks on Burnet and Whiston attracted the notice of those at Christ Church. Writing to Gough in 1698 about Keill's first attack on Burnet and Whiston, George Smalridge stated

> Mr. Keil, whom I am well acquainted with, is a plain, rough, honest, thorough Scholar, and his book answers that character. I am not master enough of Mathematics to understand him always; but, where I do, I am convinced he is in the right; and those who are better skilled are satisfied he has demonstratively confuted all the material things in Dr. Burnet's Theory.[123]

More than ten years after Keill's original attack, Atterbury still pointed to world-making as symbolic for England's religious decline. The Scriblerians portrayed Martinus, who learned of the history of the bible by viewing puppet shows on the creation of the world, as a great critic inspired by Bentley. Gay, Pope and Arbuthnot's play *Three hours after marriage* (1717) poked fun at the main character 'Fossil' (ie Woodward) while at the same time ridiculing world-

making. Keill's attacks on Burnet and Whiston, and his criticisms of Bentley and Wotton in the 1698 *Examination*, the same year the Christ Church wits mocked Bentley, may explain his and Gregory's transference from Baillol to Christ Church a few years later. Multiple intellectual issues converged to make world-making loathsome to Tories at Christ Church.

What were Newton's own opinions about world-making? Despite his relative silence about these issues in public, Newton entertained such speculations. He had corresponded with Burnet on the above matters and had supported Whiston, Newton's successor as Lucasian professor, after the publication of his *New theory of the earth*.[124] Like Whiston, Newton believed comets were agents of divine providence. In Newton's cosmogony light from the sun congealed with earthy substance to form moons that were eventually transformed into planets and then comets. These comets fell back into the sun; nature was thus a perpetual worker. Comets could disturb the orbits of moons and planets resulting in their transformation into planets and comets or fall into the sun leading to the scorching of the earth. For Newton the timing of such events was indicative of God's providential hand. Newton's had communicated these views to John Conduitt but was hesitant to air them in public.[125] The negative reactions to world-making among Anglican divines would have certainly discouraged him.

Given Newton's reluctance to provide a strong public statement of his opinions, individuals on both sides of the debate appropriated him for their own purposes. This is most evident in the dispute between Whiston and Keill. In response to Keill's *Examination* of 1698 Whiston published *A vindication of the new theory of the earth* the same year. The preface to this work provided an historical account of the formation of Whiston's theory and attributed to both

Newton and Bentley an important role in the publication of his book. Regarding the *New theory* Whiston claimed that he had

> drew up a hasty imperfect draught of my notions, to communicate to some Friends, and especially to Dr. Bentley immediately, and to Mr. Newton afterwards, whom I accordingly waited on, the first at London, and the other as I (in attendance on my Lord Bishop of Norwich) pass'd by Cambridge; which was, I think, about Whitsonside, the same Year 1695. And having now by the Hints and Directions I received from these Learned Persons, especially from the latter…..I found my self prepar'd to digest the whole into a Systeme, and began to make it ready for Mr. Newton's Review.[126]

A year later Keill responded. In reply to Whiston's use of Newton in defence of his work, Keill declared

> But however, since I have read this History of its Birth, I am less surpriz'd at the mistakes I meet with in it; since that very Learned Friend of his, upon whose judgement he seems chiefly to rely, (for I dare venture to say Mr. Newton wont engage for the truth of all his Theorems) has given the World reason enough to suspect him, none of the shrewdest Judges of that part of Learning.[127]

What the reasons were for suspecting Whiston "none of the shrewdest Judges of that part of Learning" is unclear. However, what is certain is that Keill thought Newton was sceptical of and stood above world-making speculations. Newton's reluctance to engage in such public controversies made such an interpretation possible.

Interestingly Pitcairne and Gregory were more supportive of world-making; for them Whiston was closer to the true Newtonian position. The previous chapter illustrated an intellectual convergence between Scottish Episcopalians and English Latitudinarians on particular issues relating to reason and faith. With this in mind, it is not surprising that Gregory and Pitcairne were more receptive to world-making. Gregory was intrigued with Newton's own speculations on this topic. His memoranda reveal that he had discussions with Newton about the providential role of comets.[128] His *Astronomia physicae et gemetricae elementa*

claimed that comets were possible causes of catastrophic changes on earth. Like Newton, he speculated that the gravitational attraction of comets caused changes in the orbits of moons and planets, resulting in their transformation into other heavenly bodies.[129] Pitcairne was also more receptive to world-making than Keill. He was hostile to Keill's attack on Whiston believing that Whiston really represented Newton's views. In a letter written in 1709 Pitcairne wrote that

> Mr. Whiston wrote on the way of the deluge. it was a paper given him by Mr. Newton. Mr. Whiston needleslie spoke of other things too. Keil fell upon him scurriliouslie (ie) upon Mr. Newton reallie (this lost him the profession at Oxford) [in 1708] and wold needs prove by geometrie that the deluge was a miracle (ie) That the rules of Attraction demonstrate by Sir Isaac are false. but the ill natur'd curr thinking to please a popish humour that sticks to some protestant divines, did not see That if Mr.Whiston's (ie) Newton's thought was wrong. no deluge could have been.[130]

Pitcairne had no patience for miraculous accounts of the deluge and was much more open to mechanistic explanations. This quote also suggests an additional reason for Keill's failure to initially obtain the Savilain chair in 1708: with his attacks on Whiston he lost Newton's patronage, something he likely regained with his later assaults on Leibniz, beginning in 1711.

Newton's silence on contentious issues like world-making helps explain his reputation among Oxford Tory Newtonians as a loyal Anglican despite his anti-Trinitarianism. Although Whiston was expelled from Cambridge for his Arian views and the Newtonian Samuel Clarke provoked much controversy by the publication of his *Scripture doctrine of the Trinity* (1712), Newton's anti-Trinitarian beliefs remained hidden. As Stephan Snobelen has noted, Newton was silent, Clarke hesitant and Whiston shouted from the rooftops.[131] Newton could be disassociated from anti-Trinitarianism as with the world-making of some of his followers. The Arianism of the Whigs Whiston and Clarke did not tar Newton's reputation among Tories at Oxford. Instead the Newtonian universe

with its vast void spaces and attractive powers was evidence of God's direct providence independent of secondary mechanisms.

At Oxford there was a concerted effort to portray Newton as a pious and modest natural philosopher. Scottish Newtonians who settled at Oxford and their English converts such as Freind made an effort to integrate into Oxford High-Church culture and to appropriate Newton for the Tory High-Church cause. Newton's reverence for the ancients, cautious experimental methodology and unwillingness to venture into religious controversy made this possible. At a more general level, Tory High-Church literary men with limited interest in natural philosophy saw Newtonian natural philosophy as providing a safe alternative to rival philosophies of nature. Newton was not one of the vain moderns who promoted heretical ideas, but an orthodox philosopher whose cosmology emphasised God's immanence and miraculous providence in the universe.

Most importantly, Newton's humility could be contrasted with anti-Trinitarians, deists and freethinkers who challenged the clerical establishment. By exalting reason and defending liberty of conscience heterodox thinkers disputed the role of the Anglican Church as a final judge of religious orthodoxy. Given the important function of the Church of England in the defence of divine right ideology, patriarchy and social hierarchy such an attack on ecclesiastical authority threatened to break the social bonds that glued society together – it endangered the eighteenth century confessional state. Championing Newton for the Tory High-Church cause was an important ideological blow, especially since radical scholars promoting the 'new philosophy' in the name of reason often conducted these attacks.

Tory High-Churchmen who opposed Newton in the early eighteenth century had a much different view of him. For men such as George Berkeley, Robert Greene, Roger North and John Hutchinson Newton was not the skilful mathematician and careful experimental philosopher who refrained from speculative hypotheses. Instead, the queries to the *Opticks*, especially those relating to attractive powers and matter theory, exposed Newton to attack. Not only were these speculations unjustified and based on faulty methods, they could also have heretical consequences and lead to the destruction of Church and Monarchy. In their opinion, Newton was very much connected to the freethinking of his age.

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[30] For this view of Descartes see Michael Heyd, *'Be sober and reasonable': the critique of enthusiasm in the seventeenth and early eighteenth centuries* (Leyden, 1995), chap. 4.
[31] Jonathan Swift, *op. cit*. (ref 27), 244.
[32] In *Gulliver's Travels* Aristotle criticized the rage for attraction: "He said, that new systems of nature were but new fashions, which would vary in every age; and even those who pretended to demonstrate them from mathematical principles would flourish but a short time, and be out of vogue when that was determined." Jonathan Swift, *Gulliver's*

Travels, eds Peter Dixon & John Chalker (London, Penguin Reprint, 1985), 243. For Swift's role in satires of world-makers like Whiston see G.S. Rousseau, " 'Wicked Whiston' and the Scriblerians, another ancients-moderns controversy," *Studies in eighteenth century culture*, xvii (1987), 17-44. Swift's resistance to the incorporation of scientific methods into the arts has been discussed in Douglas L. Patey, "Swift's satire on science and the structure of *Gulliver's travels*," *English literary history*, lviii (1991), 309-39. For Swift's opposition to projectors see Pat Rogers, "Gulliver and the engineers," *Modern language review*, lxx (1975), 260-70.

[33] Steven Shapin, *A social history of truth: civility and science in seventeenth-century England* (Chicago, 1994), esp. chap 4. While it may be true that the project in the Academy of Lagado (book III of *Gulliver's* travels) to distinguish color by smell and taste was drawn from Boyle's observations of a blind man who had this ability, Boyle never plays a major role in Swift's satires.

[34] Charles Kerby-Miller (ed.), *The memoirs of the extraordinary life, works and discoveries of Martinus Scriblerus* (New Haven, 1950), 168.

[35] John Keill, *An examination of Dr. Burnet's theory of the earth together with some remarks on Mr. Whiston's new theory of the Earth* (Oxford, 1698), 15.

[36] *Ibid*., 70.

[37] Smalridge-Gough (1696) in John Nichols (ed.), *op. cit* (ref 9), iii, 261.

[38] William Wotton, *Reflections upon ancient and modern learning*, (3rd ed., London, 1705), 476-477. My italics.

[39] *Ibid*., 482; Cheyne's plagiarism of Bentley was noted by Gregory noted himself. W.G. Hiscock (ed.) *David Gregory, Isaac Newton and their circle* (Oxford, 1937), 25.

[40] George Aitken in his *Life and works of John Arbuthnot* (Oxford, 1892) attributes this work to Arbuthnot. More recently Samuel Halkett and John Laing in their *Dictionary of anonymous and pseudoanonymous English literature* (Edinburgh, 1926), ii, 202 have claimed that the work was a joint composition of Arbuthnot and Keill.

[41] See especially Mordechai Feingold, *The mathematician's apprenticeship: science, universities and society in England 1560-1640* (Cambridge, 1984), chap vi.

[42] George Aitken, *op. cit*. (ref 40), 411.

[43] Christina Eagles, "David Gregory and Newtonian science" *British journal for the history of science*, x (1977), 216-225.

[44] These included Wright's *Correction of errors in navigation*, Colson's *Seaman's calendar* and Eldridge's *Gunner's glass* among others. See Christ Church MSS 346, 152. Most of Ch Ch MSS 346 was published by Hiscock (ed.), *op. cit*. (ref 39). However, there was much information that he omitted. Subsequent references to Ch Ch MSS 346 will only refer to these omissions.

[45] *Ibid*., 163.

[46] For a summary of this proposal see Arthur Charlett, *Mercurius Oxoniensis or the Oxford intelligencer for the year of our Lord 1707* (London, 1707), 26-29. The above course originated from late 1700. Charlett wrote to Samuel Pepys that Dr. Wallis is "writing somewhat by way of letter recommending the teaching and study of Mathematicks within the two Universitys..... in which I hope he will insert this proposal of Dr. Gregory's, and print it afterwards in the *Transactions*" Charlett to Pepys, Oct 15, 1700 in J.R. Tanner (ed.) *Private correspondence and miscellaneous papers of Samuel Pepys* (London, 1926), ii, 91.

[47] John Arbuthnot, *An examination of Dr. Woodward's account of the deluge* (London, 1697). When Woodward criticized Freind's *Hippocratis de morbis popularibus* (1717) in his *The state of physick* (1718) over the proper method for treating small-pox, a pamphlet dispute arose between both sides. See Joseph Levine, *op. cit*. (ref 16), *Dr. Woodward's Shield*, chap. 1.

[48] John Nichols (ed.), *The Original Works of William King* (London, 1776), ii, 5.

[49] J.A.I. Champion, *op. cit*. (ref 7), esp., chap 5.

[50] Robert Markley, "Newton, corruption, and the tradition of universal history," in James E. Force & Richard H. Popkin (eds), *op. cit.* (ref 3), 121-143, p. 135.
[51] For this aspect of Newton's thought see especially Rob Iliffe, "Those 'whose business it is to cavill' Newton's anti-Catholicism," in James E. Force & Richard H. Popkin (eds), *op. cit.* (ref 3), 97-119 and Kenneth J. Knoespel, "Interpretive strategies in Newton's *theologiae gentiles origins philosophiae*," in James E. Force & Richard H. Popkin (ed.), *op. cit.* (ref 3), 179-202.
[52] J.E. McGuire & P.M. Rattansi, *op. cit.* (ref 3).
[53] For the appeal of Hermes Trismegistus during the early modern period see Francis A. Yates, *Giordano Bruno and the Hermetic tradition* (Chicago, 1964).
[54] H.W. Turnbull (ed.), *The Correspondence of Isaac Newton*, iii (Cambridge, 1961), 338.
[55] *Ibid.*, 384.
[56] J.E. McGuire & P.M. Rattansi, *op. cit* (ref 3), 108-143, p. 111.
[57] All quotes from the preface are taken from the English translation. David Gregory, *The elements of astronomy* (London, 1715), pref., iii.
[58] *Ibid.*, pref., iv.
[59] George Aitken, *op. cit* (40), 414.
[60] John Keill, *An introduction to the true astronomy: or, astronomical lectures read in the astronomical school of the university of Oxford* (London, 1721), pref ix. This work was originally published in Latin in 1718.
[61] Thomas Hearne, *Remarks and collections of Thomas Hearne*, ed. D.W. Rannie, iv (Oxford, 1898), 69.
[62] The Lucasian Papers are in two boxes in Cambridge University Library. The Papers are divided into numerous folders the contents of which have been indexed. It is folder ten which contains "Dr. Keill's speech on being made professor." Classmark: UA 0.XIV.278.10 (II).
[63] *Ibid.*, f. 1. I have received help with the Latin translation from Professor J.B. Hall of the Classics department University of Leeds.
[64] For Keill's role in the calculus dispute see A.R. Hall, *Philosophers at war: the quarrel between Newton and Leibniz* (Cambridge, 1980). For an examination of the relationship between Newtonianism and the Hanoverian Succession see Steven Shapin, "Of god and kings: natural philosophy and politics in the Leibniz-Clarke," *Isis*, lxxii (1981), 187-215.
[65] "Dr. Keill's Speech," *op. cit.* (ref 62), ff. 1v-2.
[66] *Ibid.*, f 2v.
[67] William Temple, "An Essay upon the Ancient and Modern Learning," in *op. cit.* (ref 24), i, 151-169, pp. 153-154.
[68] Thomas Hearne, *op. cit.* (ref 18), i, 89.
[69] Harold, Williams (ed.), *The Correspondence of Jonathan Swift*i (Oxford, 1963-65), i, 121.
[70] W.R. Ward, *Georgian Oxford. University politics in the eighteenth century* (Oxford, 1958), 32-33.
[71] Thomas Hearne, *op. cit*, (ref 18), i, 303.
[72] In the Lucasian Papers among Keill's writings is a report to the Lord High Treasurer of England detailing the settlement of families from the Palatinate in New York. UA 0.XIV.278.9 (XIII).
[73] UA 0.XIV.278.10 (V). Smalridge's speech in favor of Atterbury can be found in Francis Atterbury, *op. cit.* (ref 12), i, 303-311.
[74] Francis Atterbury, *op.cit* (ref 12), i, 181.
[75] George Sherburn (ed.), *The correspondence of Alexander Pope*, (Oxford, 1956), ii, 459.
[76] This is admirably explored in J.R.R. Martin's excellent piece "Explaining John Friend's *history of physic*," *Studies in history and philosophy of science*, xix (1988), 399-418. Much of this section is influenced by Martin's essay.

[77] John Freind, *The history of physick from the time of Galen to the beginning of the sixteenth century chiefly with regard to practise in a discourse written to Dr. Mead* (London, 1725-1726), i, 301.
[78] *Ibid*., ii, 19-20.
[79] *Ibid*., ii, 232.
[80] *Ibid*., ii, 396.
[81] *Ibid*., ii, 398-99.
[82] All quotes are taken from the translation of the Latin edition of 1703. See John Freind, *Emmenologia*, ed. Thomas Dale (London, 1729), 212.
[83] *Ibid*., 216.
[84] *Ibid*., 215.
[85] John Freind *op.cit*. (ref 77), ii, 397.
[86] *Ibid*., i, 303.
[87] *Ibid*., i, 305.
[88] Steven Shapin, *op. cit*. (ref 33)
[89] Thomas Baker, *Reflections upon learning wherein is shewn the insufficiency thereof, in its several particulars in order to evidence the usefulness and necessity of revelation* (London, 1699), 239.
[90] Isaac Newton, *Principia,* ed. I.B. Cohen & A. Whitman (Berkeley, 1999), 382-383.
[91] Isaac Newton, *Opticks*, ed. E.T. Whittaker (London, 1931), 401.
[92] Isaac Newton, *op. cit*. (ref 90), 944.
[93] John Keill, "On the laws of attraction and other physical principles," in G. Hutton, G. Shaw & R. Pearson (eds), *Philosophical transactions* (London, 1809), 417-424, pp. 418-419. Most of this paper was translated from the original Latin in this edition.
[94] John Friend, *Chymical lectures: in which almost all the operations of chymistry are reduced to their true principles and laws of nature read in the museum of Oxford 1704*, ed. Thomas Dale (London, 1729), pref vi. The *Praelectiones chymiae* was first published in 1709.
[95] *Ibid*., 176. This quote is found in an appendix appended to the first Latin translation in 1712 and in successive England and Latin editions.
[96] Isaac Newton, *op. cit*. (ref 90), 943. Note: the second edition had the word experimental instead of natural.
[97] Quoted in Stephan Gaukroger, *Descartes' system of natural philosophy* (Cambridge, 2002), 56.
[98] John Keill, *op cit*. (ref 35), 11-12.
[99] W.G. Hiscock (ed.), o*p. cit*. (ref 39), 30.
[100] For reactions against Descartes and Spinoza see John J. Dahm, "Science and apologetics in the early Boyle Lectures," *Church history*, xxxix (1970), 172-190. Many Newtonians made connections between Leibniz and pantheists such as John Toland. See Steven Shapin, *op. cit*. (ref 64), 187-215.
[101] Steven Shapin, *op. cit*. (ref 64), 187-215
[102] For Keill's role in this controversy see A. Rupert Hall, *op. cit*. (ref 64), esp. chaps 5-9.
[103] A.R. Hall & L. Tilling (eds), *The Correspondence of Isaac Newton*, vi (Cambridge, 1976), 22
[104] *Ibid*., 171
[105] John Freind, *op. cit*. (ref 94), 189. This passage from the 1729 English translation has been imperfectly translated from earlier Latin editions of the appendix (See note 95), although the quote's meaning retains its original sense. The quote should read: "all this mass of the universe is governed and ruled through the varied movement of bodies, its cohesion and harmony is preserved although indeed this very power no less than all of nature has uniquely flowed from the divine will but those persons who recognise no law of this kind but wish the whole business of physics not only as regards proximate causes but also most distant causes, is carried out by its own nature and by a sort of mechanical

reasoning so that there is nothing which they do not think starts from the very face of matter and the immutable condition of movement – what else are they doing except riping out of the minds of men along with Epicurus the notion of a God that foresees and controls all things, and provides proofs which impious persons may draw cross for their own impious ends." My thanks to Professor J.B. Hall for help with the Latin.

[106] Thomas Baker, *op. cit.* (ref 89), 85.

[107] For a good survey of world-making during this period see David Kubrin, "Providence and the mechanical philosophy: the creation and dissolution of the world in Newtonian thought" (PhD thesis, Cornell University, 1968).

[108] The 1689 Latin and 1690 English editions provided two additional books.

[109] Thomas Burnet, *The theory of the Earth containing an account of the original of the earth and of all the general changes which it hath already undergone or is to undergo till the consummation of all things. The two first books concerning the deluge and concerning paradise* (London, 1684), 6.

[110] The *Archaelogiae* was later translated in 1729 and 1736. I'm using the latter edition. See Thomas Burnet, *Archaelogiae philosophicae: or, the Ancient Doctrine Concerning the Original of Things*..... (London, 1736), 46.

[111] John Woodward, *An essay toward a natural history of the earth and terrestrial bodies, especially minerals: as also of the seas, rivers, and springs. With an account of the universal deluge* (London, 1695), pref ii-iii.

[112] William Whiston, *A new theory of the Earth* (New York, Arno Reprint, 1978), 3.

[113] John Keill, *op. cit.* (ref 35), 178-179.

[114] John Keill, *An examination of the reflections on the theory of the Earth together with a defense of the remarks on Mr. Whiston's new theory* (Oxford, 1699), 176.

[115] John Keill, *op. cit.* (ref 35), 21-22.

[116] *Ibid.*, 179.

[117] John Arbuthnot, *An examination of Dr. Woodward's account of the deluge with a comparison between Steno's philosophy and the doctor's, in the case of marine bodies dug out of the Earth* (London, 1697), 29.

[118] *Ibid.*, 63.

[119] Richard Marsh, *The vanity and danger of modern theories. A sermon preach'd at St. Mary's Church in Cambridge on August 13,1699* (Cambridge, 1699), 10. See Thomas Baker, *op. cit.* (ref 89), 83 for his attacks on world-making.

[120] Charles Kerby-Miller (ed.), *op. cit.* (ref 34), 167.

[121] Jonathan Swift, *op. cit* (ref 32), 206-207.

[122] For Whiston's public lecturing see Larry Stewart, *The rise of public science* (Cambridge, 1992) and James Force, *William Whiston: honest Newtonian* (Cambridge, 1985).

[123] Smalridge to Gough 1698, in John Nichols (ed.), *op. cit.* (ref 9), iii, 271.

[124] James Force, *op. cit.* (ref 122), 49-53.

[125] For an excellent discussion of Newton's cosmogony see David Kubrin's "Newton and the cyclical cosmos: providence and the mechanical philosophy," *Journal of the history of ideas*, xxviii (1967), 325-346.

[126] William Whiston, *A vindication of the new theory of the Earth from the exceptions of Mr. Keill and others with an historical preface of the occasions of the discoveries therein contain'd* (London, 1698), pref vi-vii.

[127] John Keill, *op. cit.* (ref 114), 164.

[128] A good example of this is a discussion Gregory had with Newton in May 1694. Gregory stated that Newton said "that a continual miracle is needed to prevent the Sun and the fixed stars from rushing together through gravity: that the great eccentricity in Comets in directions both different from and contrary to the planets indicates a divine hand: and implies that the Comets are destined for a use other than that of the planets." H.W. Turnbull (ed.), *op. cit.* (ref 54), iii, 336.

[129] David Gregory, *op. cit.* (ref 57), 852-854.

[130] Pitcairne to Dr. Walkinshaw Dec 27, 1709 in W.T. Johnston (ed.) *The best of our owne: letters of Archibald Pitcairne, 1652-1713* (Edinburgh, 1979), 56-57.
[131] Stephan Snobelen, "Caution, conscience and the Newtonian reformation: the public and private heresies of Newton, Clarke and Whiston," *Enlightenment and dissent*, xvi (1997), 151-184. For the controversies surrounding Clarke's *Scripture Doctrine of the Trinity* see Larry Stewart, "Samuel Clarke, Newtonianism and the factions of post-revolutionary England," *Journal of the history of ideas* xlii (1981), 53-72.

Robert Greene and the philosophy of expansive and contractive forces

The existence of several Tory High-Church Newtonians at Oxford in the early eighteenth century illustrates how some Tory High-Church intellectuals saw Newton as an exponent of the moderate mainstream Enlightenment. However, some Tory High-Churchmen disagreed with this interpretation of Newton and viewed him as an apologist for radical and heterodox thought. Several individuals within the Tory camp worried that Newtonian natural philosophy was gaining authority and popularity to the extent of bidding fair to become an intellectual orthodoxy. But this orthodoxy appeared to entrain religious heterodoxy that penetrated the core of the established church, and was successively gaining sway in terms of ecclesiastical and party politics, especially after 1715.

One such person was the Cambridge scholar Robert Greene who believed the Newtonian universe – with its promotion of atoms and a void – was a variant of the ancient cosmology of Epicurus. Epicurus had limited the providential role of the Gods in human affairs by reducing all natural phenomena to matter in motion. Materialist corpuscular philosophers such as Locke, Spinoza, Descartes and Hobbes had also incorporated certain elements of ancient atomism into their thought, namely the existence of an invisible substratum of matter. Greene saw Newton as advancing doctrines similar to the above philosophers, men known or suspected for their religious heterodoxy. He sought to counter Newton, the new prince of the corpuscular philosophers, by offering an alternative natural philosophy of expansive and contractive forces. This was part of a project to spiritualise nature and to defend scripture.

Tory fellow of Clare Hall

Scholars have largely ignored the political and religious context in which Greene wrote and its relationship to his critiques of the corpuscular and Newtonian natural philosophies.[1] The scholarly neglect of Greene's three works: *A demonstration of the truth and divinity of the Christian religion* (1711), *The principles of natural philosophy* (1712) and the massive *Principles of the philosophy of the expansive and contractive forces* (1727) can be attributed in part to the incoherence and unintelligibility of his writings. Robert Schofield has described the last work as a "tangle of rationalisation and contention, in an enormous mass from which the sections relating to matter and its action must be extracted and ordered."[2] While Greene's writing is often obscure and his arguments frequently appear nonsensical, there is a unity and purpose behind his works that needs to be explored, especially in relation to the political and religious context in which he worked.

Unfortunately historians of science have studied Greene's works only to illustrate the predominance of certain strands of eighteenth century thought. While Schofield has divided eighteenth century natural philosophy into forms of mechanism and materialism and located Greene in the later group, Arnold Thackray has interpreted Greene's opposition to the inertial homogeneity of matter and a vacuum as an example of resistance to Newtonian ideas as they relate to chemistry and matter theory.[3] In a highly influential article Heimann and McGuire have argued that Greene's rejection of corpuscularism and his identification of force with matter was an example of the growing tendency of

eighteenth century natural philosophers to attribute force or power to matter.[4] Some attempt has been made by Rom Harre to study Greene's epistemology within a theological context, particularly relating to concerns that Lockean philosophy could lead to religious scepticism.[5] But even here there has been little effort to connect religious issues with the politics of Greene.

What is clear is that Greene's anti-corpuscularianism, which he associated with the Lockean doctrine of abstract ideas, originated as a young Tory High-Church scholar at Whig Cambridge. He matriculated at Clare Hall in 1694 receiving his M.A. in 1703, the same year he was made fellow of the college, a position he held until his death in 1730. Greene's anti-corpuscularism and opposition to abstract ideas dated from his undergraduate days and predated the publication of Newton's *Optice*. In the preface to his *Principles of the philosophy of the expansive and contractive forces* he stated that

> when I was an Under-graduate in this University, and could not see the Reason for the Abstractions, which Mathematicians and Philosophers made Use of in their several Sciences, I Applied myself to the late Reverend Dr. Laughton, who was then Eminent in those studies, was in Part my Tutor and my Friend, and who very kindly Endeavour'd to Instruct me, so far as he could, in those Matters, but without giving me any farther information.[6]

Greene's mention of Richard Laughton is significant given Laughton's role as a teacher at Clare where he and his fellow Whig William Whiston were active teaching.[7] It appears that shortly after receiving his M.A. Greene became a teaching rival to his former tutor. In 1708 out of a total of fifty-four Clare pupils Greene tutored twenty-three, while in 1710 he taught twenty-one out of seventy-two.[8] An early pedagogical work of Greene's published in 1707 illustrates the influence of corpuscular philosophers like Locke on the teaching curriculum at Clare, despite Greene's own personal reservations. After pupils had been instructed in geometry and algebra, they were to be taught metaphysics and the

corpuscular philosophy, although "the Corpuscular Philosophy itself seems in most respects to be ridiculous and trifling."[9] Five years later Greene attempted to refute corpuscularism in his *Principles of natural philosophy* (1712).

The link between the corpuscular philosophy, Newtonian natural philosophy, Whiggery and heresy was likely established in Greene's mind from his early experiences at Clare. Cambridge was Newton's university, and it was Whigs and Latitudinarians who were central to the promotion of Newtonian natural philosophy at Cambridge, part of the holy alliance that existed between Whigs, Latitudinarians and Newtonian natural philosophers, ironic considering the dominance of Tory Newtonians at Oxford.[10] Newtonian natural philosophy along with Lockean philosophy was especially popular at Trinity and Clare, and there were close links between the colleges. Trinity was the college of Newton and the Whig Newtonians Richard Bentley and Roger Cotes. Before Whiston was expelled from the university on account of his Arianism, he jointly taught a course of experimental philosophy at Trinity with Cotes. However, the promotion of Newtonian natural philosophy by Whiston and Laughton within Greene's own college must have particularly alarmed him: indeed, "the activities of both Whiston and Richard Laughton helped to make Clare a centre for the study of Newtonian natural philosophy."[11] In Whiston, Greene must have seen the heretical consequences he believed were implicit in the corpuscular and Newtonian philosophies. Indeed, Greene's 1712 dedication to Robert Harley in his *Principles of natural philosophy* stated that Harley was "Rais'd by the Providence of Almighty God for the Support and Patronage of our most Holy faith, against the Insults of the several Atheists, Deists, Socianians, and I may now say, Arrians [Whiston and Clarke?] of our Age."[12]

Greene was not alone in his fears of the heterodox uses of learning at Cambridge. St. John's was also a centre of opposition to Lockean philosophy among individuals who opposed the post-revolutionary settlement. Fellows such as Robert Jenkin, Matthew Prior and John Edwards criticised Locke, as did Henry Lee of Emmanuel in his *Antiscepticism, or notes upon each chapter of Locke's Essay* (1702). Lee thought (as did Greene) that Locke's assertion that knowledge was the agreement and disagreement of ideas would lead to philosophical and religious scepticism.[13] Other fellows at St. John's expressed alarm with the threat that reason posed to revelation. Works like Richard Marsh's *The vanity and danger of modern theories* (1699) and Thomas Baker's *Reflections on learning* (1699) upheld the superiority of revealed knowledge to that known through reason. As the last chapter showed, the latter two men were particularly alarmed by attempts to explain the Mosaic history of the creation and the flood through modern philosophy.

However, what makes Greene unique was his willingness to criticise Newton and offer a philosophical alternative. Notwithstanding High-Church alarms at Cambridge about the heterodox uses of natural philosophy, Newton was no more subject to attack than at Oxford. The above works of Marsh and Baker rarely mentioned Newton, and Baker was even willing to admit that Newton's "notion of attraction may be true and pious" although "thought by some as unphilosophical."[14] A year before Greene's death in 1730 the Jacobite John Byrom of Trinity visited him and conversed with Greene about philosophical matters. He noted in his journal: "much talk with Dr. Greene and Nichol about his Philosophy of contractive and expansive forces, they said space was nothing, that all matter was active and not passive."[15] Yet Byrom and his associate, the

High-Churchman William Law, would later attempt to reconcile Newtonian natural philosophy with the mystical religion of Jacob Boehme, indicating that Byrom had failed to be converted to the Greenian philosophy.[16]

Greene's willingness to challenge Newton can be attributed in part to his own high opinion of his abilities and his own eccentricity. This eccentricity is perhaps best encapsulated in the details of Robert Greene's will. In the will

> he named eight executors, five being of Cambridge colleges and directed that his body should be dissected and the skeleton hung up in the library of King's College; monuments to his memory were to be placed in the chapels of Clare and King's colleges, in St. Mary's Church, and at Tamworth, for each of which he supplied a long and extravagant description of himself.[17]

Greene was not intimidated from challenging one of the most respected and revered figures of post-revolutionary England. He thought that he could offer alternative principles of knowledge and nature that would provide a better defence of religion than Newton whose doctrines of atoms and a void were associated with Epicureanism.

Greene's anti-corpuscularism

While Greene's work has been noticed for its opposition to Newton, what is more evident from an examination of his *Principles of natural philosophy* and *Principles of the philosophy of the expansive and contractive forces* is his thorough anti-corpuscularism. Indeed, in his writings he saved most of his venom for philosophers such as Descartes, Hobbes, Spinoza and Locke. When Greene attacked reason in his works, he was attacking the type of reasoning associated with the corpuscular philosophy, especially that of the Whig Locke. The compounding and abstracting of ideas and the definition of a homogeneous

matter in terms of primary and secondary qualities were thought responsible for all the uncertain hypotheses in natural philosophy. From the beginning of his *Principles of natural philosophy*, in his dedication to Robert Harley, Greene stated that he would "Evince, what Little Satisfaction we are to Expect from Reason, and even from those, who have enter'd into the Depths of it with the utmost Genius and Penetration."[18] Greene associated reason with the Lockean doctrine of abstract ideas and theories of knowledge based on the agreement and disagreement of ideas.

Locke's philosophy needs specific examination. Locke in his *Essay concerning human understanding* rejected Cartesian innate ideas claiming that all our knowledge was a product of sensory perception and reflection upon the internal operations of our minds. Simple ideas of sense could be combined to form complex ideas, and these ideas could be abstracted "whereby Ideas taken from particular Beings, become general Representatives of all of the same kind; and their names general Names applicable to whatever exists conformable to such abstract ideas."[19] In his *Principles of the philosophy of the expansive and contractive forces*, which was divided into seven books, Greene devoted an entire book to a refutation of Lockean philosophy. In contrast to Locke who believed that simple ideas were the foundation of our knowledge and of our complex ideas, Greene asserted "the Complex Ideas, which it [the mind] Receives from External Nature, are the Foundation and Materials of it's Knowledge."[20] Although Greene thought our ability to compare, compound and abstract ideas distinguished human minds from those of brutes, the abuse of such a God-given mental capacity led to error. Indeed, Greene declared that if it is "farther Insinuated, That these Simple Ideas Enter the Mind Singly and not in

Conjunction with others, or, That, altho' they do Enter in Conjunction with others, the Mind may afterwards Consider them, as Single and Independent Ideas, and Unite and Compound them at Pleasure; The First is False in Fact, and the Last a mere Chimera."[21]

Greene associated Lockean abstractions with the corpuscular philosophy and the distinctions between primary and secondary qualities. He defined abstraction as the process by which "we Frame General Ideas, and Separate and Disunite every Thing from them, which shall Render them Particular."[22] Greene believed that the primary qualities of the corpuscular philosophy such as extension, solidity, figure and motion were based on such abstractions. Both Greene's *Principles of natural philosophy* and *Principles of the philosophy of the expansive and contractive forces* were largely critiques of the belief in homogeneous matter that could be defined in terms of its primary qualities. Because these qualities were based on the uncertain generalisations or abstractions of the mind, they could not serve as a basis to explain secondary qualities of bodies such as light, colour and taste. The goal of the corpuscular philosopher to explain natural phenomena by the figure, motion and arrangement of the microscopic parts of matter was therefore absurd. The distinction between primary and secondary qualities "is only made Necessary by the Abundant Follies and Absurdities of the Corpuscular Systeme, or the Systeme of a Similar and Homogeneous Matter."[23] Reason as practised by corpuscular philosophers could not arrive at certain knowledge of phenomena.

The last point is particularly important, since Greene worried arguments to prove the existence of God through philosophical reason (as he defined it) were faulty much like corpuscular speculations. In particular Greene criticised the

Lockean doctrine of the connection of ideas. In his *Essay concerning human understanding* Locke defined knowledge "to be nothing but the perception of the connexion and agreement, or disagreement and repugnancy of any of our ideas."[24] Humans could ascertain whether agreements or disagreements between ideas existed through intuition or intervening proofs as in mathematics. In book four, chapter ten Locke offered an intuitive proof for the existence of God that he believed carried the same weight as a mathematical demonstration. His argument was simple: since man had a clear perception of his own existence he knew "by an intuitive Certainty, that bare nothing can no more produce any real Being, than it can be equal to two right Angles."[25] Samuel Clarke in his series of Boyle lectures collectively titled *A demonstration of the being and attributes of God* (1704) also used deductive and mathematical forms of discourse to prove the existence of God. From a series of successive dependent beings in the universe, Clarke concluded that there must be of necessity one universal self-existent first cause.

In book six of his *Principles of the philosophy of the expansive and contractive forces* Greene attacked Locke and Clarke as well as Descartes. He associated philosophical proofs for the existence of God with the abstractions of the corpuscular philosophy. Instead of connecting ideas he attempted to provide proofs for the existence of God through a sensationalist view of knowledge. God's existence was not known through a comparison of ideas framed by the mind but

> from a bare View of all those Beings in the Universe, which Surround us; which, when we Look upon only, we are, without any Laboured Deductions of Reason, as fully Carried into an immediate Acknowledgement of a Supreme Author, as when we Look upon an Exquisite Picture, or a Landskip, we are Satisfied, it was Drawn by some Skillful Hand; and yet , if we were to set our

> Selves to the Proving of the Latter by the Method of Connecting Ideas, it would be impossible.[26]

Faulty knowledge of nature, such as that based on Lockean abstractions, would lead to weak defences of Christianity. Correspondingly Greene felt compelled to argue against natural theologians such as Locke and Clarke by offering his own natural system of expansive and contractive forces that provided a certain demonstration of God's existence and providence. Unless humans had such a proper understanding they were only

> Entangled and Confounded with Idle and Metaphysical Reasonings, without being Able to affirm any Thing with solidity or Certainty; All is cobweb, and Fine Spun Thoughts, and Nice Speculations, and we shall find Nothing on either Hand, unless Abundance of Abstracted Forms, Abstruse Words, and Mere Sophistry and Chicaning.[27]

Greene's reading of Newton

While Greene's primary targets in his works were corpuscular philosophers such as Locke, Hobbes and Spinoza, there is no doubt that he associated the corpuscular philosophy, particularly that variant known as atomism, with Newtonian concepts such as the nut-shell theory of matter. Greene's opposition to Newton was recognized by the editor of the second edition of the *Principia* Roger Cotes, who in a letter to Newton in 1711 wrote, "one Mr. Green of Clare Hall has now in ye Press a Book [Greene's *Principles of natural philosophy*] ..... wherein I am informed he undertakes to overthrow the Principles of Yr Philosophy."[28] Greene was willing to admit Newton's great intellectual abilities. However, he had mistakenly been led into errors by philosophers before him such as Spinoza, Hobbes, Descartes and Locke: "...that Men of Sagacity and Learning, of the utmost Probity and Goodness, and the greatest and most exalted

Genius's of their Times, should fall in with the same Notions, can be no other ways explain'd, than from their being unwarily led into them, by the Authority and Impression of those who writ before them."[29] While these mechanical philosophers differed in many respects among themselves they all believed in the corpuscular constitution of matter. Newton gave explicit sanction to such views in the queries to the *Opticks*, especially those added to the 1706 Latin edition. Although Greene admired Newton in many respects he dissented from him in most particulars.

For Greene Newtonian natural philosophy promoted the ancient atomism of Epicurus and Lucretius. According to both ancient philosophers atoms were eternal and the building blocks of all matter. All compound bodies were composed of various random combinations of atoms in vacuous space. The qualities of bodies were the product of these multiple arrangements. Certainly Newton incorporated elements of Epicureanism into his natural philosophy. With his strong defence of a vacuum and atomism in the Latin *Optice*, Newton's debt to Epicurus and Lucretius is clear, and Newton often appealed to ancient authorities such as Epicurus to justify his claims. Greene interpreted Newton's defence of atomism and the porosity of matter as an apology for a universe governed by the random collision of indestructible eternal atoms instead of divine spirit, despite Newton's attempts to combine ancient atomism with spiritual elements drawn from Platonic and Stoic philosophy.[30]

Greene's reading of Newton is interesting. While he certainly incorporated elements of Epicureanism into his natural philosophy, Newton rejected the notion that atoms were eternal and strongly promoted a providential God. In contrast to Epicurus and Lucretius, Newton did not believe that God remained aloof from

the affairs of the world. God created atoms and continued to exercise His influence. Newton's supporters such as the Oxford Newtonians believed that Newtonian natural philosophy provided a strong defence against deism by promoting God's immanence. As we shall see in succeeding chapters, several of Newton's critics accused Newton of pantheism due to his advocacy of active/divine powers in space.

Why then did Greene make the above association? As he noted in the preface to his *Principles of natural philosophy*, the writings of previous corpuscular and atomic philosophers had convinced him that corpuscular speculations were the root of all irreligion, especially since this philosophy was promoted by its enemies like Hobbes and Spinoza. Another possible source of convergence was Newton's irreligious disciple Edmund Halley who had merged Epicureanism with Newtonian natural philosophy in his ode to the first 1687 edition of the *Principia*. According to Halley, since the Newtonian cosmos operated according to fixed laws, God would not interfere in human affairs.[31] Certainly Greene linked the defence of a vacuum with atheism. One year after Whiston was expelled from Clare College Greene declared

> where is there now one Sage Professor of Theorems and Axioms amongst them, who is not positive of a void space in the Universe? And notwithstanding this firm and invincible persuasion which they have, there is nothing more demonstrable than that all their Arguments for it, are only so many Affirmations of what was intended to be prov'd? and yet these are the men, who by the same trifling and ludicrous way, and with much jangle and insignificant proofs, endeavour to pervert and ruin our Faith.[32]

For Greene, Newton was continuing the corpuscular tradition, founded by Epicurus and extended by advocates of radical thought.

Accordingly Greene disagreed with the main tenets of Newtonian natural philosophy, as he interpreted them. While he attacked the corpuscular philosophy

in his *Principles of natural philosophy* without offering a viable alternative, the *Principles of the philosophy of the expansive and contractive forces* attempted to provide a refutation of existing natural philosophies based on atoms and corpuscles by offering a viable philosophical option. In book one chapter one of the latter work, Greene attacked the notion of a similar homogeneous matter and a vacuum. He criticised Newton's nut-shell theory of matter, advocacy of a vacuum and experiments on light and colours. Interestingly, he noted the changes Newton had made in the *Opticks* between the Latin edition and the second English edition of 1717, specifically Newton's introduction of a subtle elastic ether as the cause of gravity. Greene, who believed space was filled with a spiritual nonmaterial ether composed of an equal amount of expansive and contractive forces, had given a copy of his *Principles of natural philosophy* to Newton and interpreted this change as due to his influence.[33] Newton was becoming a convert to the Greenian position! Despite Newton's change of heart, Greene continued to group him with atomists, vacuists and Epicureans. Indeed, Newton never did rescind his belief in atoms. In contrast to Newton's natural philosophy grounded on corpuscular abstractions, Greene argued that his philosophy of expansive and contractive forces was based on simple matters of fact drawn from sensory experience.

Greene's re-definition of reason

For Greene many of the errors of modern philosophy were due to a faulty scientific method. Corpuscular philosophers were too willing to abandon the observations of sense to frame their own hypotheses about the workings of

nature. In his *Principles of the philosophy of the expansive and contractive forces*, Greene defined five different sources of knowledge applicable to knowledge of nature. He listed these in decreasing order of certainty: sensitive, intuitive, experimental, mathematical and philosophical.[34] Regarding the above categories he stated that

> The Evidence, which the Mind has from Sensation, we may Call Sensitive Knowledge, or Certainty; and That, which it has from the Intuition of it's Ideas, Intuitive; What it has from Arguing upon Sense, Experimental; and That from it's Abstraction of Ideas, we may term Mathematical; and lastly Where we Reason both from the Intuition of our Ideas, and from Sensation together, we cannot give a Juster Demonstration to it, than that of a Philosophical One.[35]

According to Greene, sensitive and intuitive knowledge were certain; they did not depend for their justification on the Lockean doctrine of the agreement or disagreement of ideas but were derived from our immediate perceptions of nature and reflection upon the operation of our minds. In contrast, experimental, mathematical and philosophical knowledge sought agreements between particular ideas or relations and involved abstractions from sensory experience and intuition. Greene believed that ideas based on direct experience achieved the status of a matter of fact, and matters of fact served as the foundation for Greene's system of nature and defence of scripture.

Greene's promotion of knowledge based on facts from sense and experience was not unique among English philosophers. Steven Shapin & Simon Schaffer have noted how members of the early Royal Society such as Robert Boyle emphasised simple matters of fact in scientific discourse in order to avoid scientific disputes.[36] Barbara Shapiro has also shown how the early Royal Society's experimental programme "concentrated on the more certain matters of fact, and moved from these to probable hypotheses."[37] Indeed, the historians

Heimann and McGuire correctly recognize that Greene's critique of the modern corpuscular philosophy appropriated certain elements of Restoration scientific practise: "with Greene it is clear that his critique of the new science was founded on a more empirical view of knowledge which itself, ironically enough, more nearly satisfied the ideology of seventeenth century science."[38] However, for Greene matters of fact did not provide a basis from which hypotheses of the inner workings of nature could be offered. Instead, he believed that our observations provided immediate certain evidence of the principles at work in nature.

For Greene testimonial knowledge found in scripture had the same certain status as the matters of fact of nature, and he elevated testimony, especially that found in the bible, to the status of certain matters of fact when defending scripture. Unlike Locke, Greene did not believe that matters of fact were more or less probable. Despite Locke's assertion that testimonial knowledge from the scriptures was highly probable or morally certain, Greene believed that such a concession inevitably led to religious scepticism. Greene charged that Locke had mistakenly claimed that

> all Sensitive and Natural Knowledge, and all Histories of Fact, as well as Those of Christianity, are Excluded from Demonstration and Certainty, and Terminate only in Faith and Opinion, which has been shown to be absurd, and that Faith and Opinion is rather the Result of the Connection of Ideas, than of fact, Sense and Experience.[39]

In Greene's mind the biblical narrative possessed its authority from the certainty of the matters of fact it related about Christ and the apostles. An appeal to faith or probability was not necessary; in the case of the latter it was positively dangerous.

In the early eighteenth century Locke had provided a discursive continuity between the evaluation of scriptural truth and the truths of nature, which was then

exploited by heterodox Anglicans and deists. Critics of the Anglican establishment such as Toland and Collins often used the Lockean apparatus of evidence, probability and reasonable truth in their attacks on the doctrine of the Trinity and priestly authority. As an argumentative discourse such an apparatus had much in common with natural philosophy, and the authority wielded by Newtonian truth appeared further to validate this methodology and its application in biblical criticism, especially due to the public anti-Trinitarian views of Clarke and Newton and, in Greene's opinion at least, the continuities between Locke's corpuscularism and Newtonian matter theory. Greene is interesting in not abandoning empiricist ground, but in re-configuring it in a counter-Lockean fashion.

It was in Greene's *Demonstration of the truth and divinity of the Christian religion* (1711) that he argued that the historical evidence for Christianity found in scripture and based on testimonial proofs had the same certainty or demonstrative status as the matters of fact of nature. This work upheld the authenticity of the written tradition of the church against the large claims made for philosophical reason. It is here that Greene's High-Church sympathies are most evident. Appended to this work was a "Discourse to prove that matters of faith are equally, if not more demonstrable, than those of reason." Greene defined faith as "a Perfect assent of the Mind to things which are not seen, a full Assurance and Conviction which we have receiv'd, and an undoubted certainty which we have of those things, which we were never Eye-witnesses of."[40] Faith depended on testimony. Because the testimony found in the bible was from people of the utmost credibility and were from multiple witnesses, they could not be considered as anything but perfect and true, and not more or less probable.

Our faith in the scriptures was therefore reasonable. In his works Greene redefined reason. Instead of deductions from first principles or hypothetical inferences from sensory phenomena, Greene merged his concept of reason with the matters of fact of observation of seventeenth century natural philosophic discourse and the oral and written traditions of the Anglican Church. He stated that the holy scriptures were in harmony with reason if by reason is meant matters of fact rather than the abstractions of the corpuscular philosophers and Newtonians. Indeed, "in Matter of Fact, or Experimental knowledge, Faith is not Opposed to reason, because Reason, in other Terms, is the Evidence we have of Fact."[41] However, if reason is understood to mean the connection of ideas as in mathematics and philosophy

> Faith is opposed to reason; since it is Impossible for us by any Methods of Connecting ideas to Prove, there is such a Place as France, or the Indies or that 1711 years ago Jerusalem was a City in Judea, and that Jesus the Messiah was afterwards Crucified in it.[42]

Greene's challenge was to formulate a new system of nature that avoided the abstractions of the corpuscular philosophy, rested on simple common sense observation, and compelled our assent in the same clear way the ancient testimony proved the truths of scripture.

Expansive and contractive forces

Greene believed he had devised just such a unique system in his *Principles of the philosophy of the expansive and contractive forces*. In this massive work Greene promoted a natural philosophy of appearances or effects – all that could be known of nature was derived from immediate sensations. This method provided a more certain basis for knowledge than the corpuscular philosophy

with its abstractions. By abolishing the quest for knowledge of hidden essences and denying the existence of the particulate composition of matter, Greene was hoping to limit philosophical discourse about the natural world to our immediate sensory perceptions.[43] The certainty of his system was based on acknowledging the limit to the range of possible knowledge about nature reducing the discussion of it to a mere surface level of effects.

Greene's solution was to abolish the traditional definitions of matter – extension, solidity and figure – and to equate matter with force. He declared that

> All this is manifest and certain, that Matter is not Homogeneous in it's own Nature, and that it's apparent Difference do's not arise from the Difference of the Situation, Figure and Magnitude of it's Parts, and that it's Powers and Qualities are not deriv'd from them in Conjunction with Motion, but from the peculiar Expansive and Contractive forces of it.[44]

Greene was opposed to Newton's belief that matter was solid, massy, impenetrable and quiescent; he thought the essence of matter was its action or force, or more specifically, expansive and contractive force. According to Greene, the existence of these two forces was a simple matter of fact drawn from our immediate perceptions of things. For example, our observations of fire gave humans incontestable proof of the action (expansive force) of fire. Correspondingly our perceptions of earthly matter provided evidence of its contractive qualities. One can see in Greene's works elements of an Aristotelian epistemology that explained knowing as the absorption of the form of objects by the mind, the form constituting the essential feature of the object. In this respect there were certain similarities in Greene's works with other early critics of Locke's theory of ideas such as the Aristotelian John Sargeant.[45]

It was from the combination of these two forces that all the properties of bodies arose.

> The substratum or Essence of Matter therefore I Take and Think I may affirm, to be Action or Force, and if I can Produce those Actions and Forces, which will not only solve all the Phenomena of Matter, which we are Acquainted with our Sensations from it.....I hope I shall have given a full account not only of the Essence of matter, but of it's Real and Essential Properties.[46]

All accidental or secondary qualities could be understood via expansive and contractive forces and not the primary qualities of a homogeneous matter. These accidental qualities included hardness, softness, fluidity, rarity, density, resiliency, heat, cold, smoothness, roughness, taste, smell, sound, light and colour. For example, gold owed its solidity to its great contractive force that counteracted its smaller expansive force. Similarly, in fluids

> by how much more Fluids Resist to a Separation of their Parts, by so much is the Contractive Force more Prevalent than the Expansive, or by how much more they are Inclined or Disposed to such a Separation without an External Force, by so much is the Expansive more Prevalent than the Contractive.[47]

This was in contrast to Newton who believed the changes in corporeal substances were due to the configurations and motions of permanent particles or atoms that, while influenced by attractive forces, were not defined in terms of force but of extension, dimension and solidity.

Even the mind was affected by the mediation of these two forces. While too much expansive force in the human body caused madness, too much contractive force resulted in melancholy. Thus by analogy these two forces could be used to explain divisions within society. Greene declared that "the World will be always Divided, so long as there are these Two Principles in our Natures; The Witty, the Cheerful, and Lively, under what Denominations of Religion or Learning soever, will be Averse to the Serious, the Grave, and the Contemplative."[48] A balance between the two was important to maintain bodily equilibrium. Greene's novel doctrine could be applied to human affairs as well as to the inanimate world.

In Greene's system of nature ether was important for the mediation of both forces and a significant counterweight to Epicurean atomism with its promotion of a vacuum. The ether "which is the subtilest matter, is caused, having neither the Expansive of the Sun, nor the Contractive of the Planets, but being Obedient to either, as their Several and particular forces Prevail."[49] The ether was not material in a corpuscular sense but was composed of an equal amount of expansive and contractive force; it was therefore inert and passive to any external impressions. In Greene's opinion, most ancient philosophers such as Plato, Aristotle and Zeno had rejected a vacuum, and the doctrine of a vacuum could easily be refuted by common-sense. Referring to Newton's nut-shell theory of matter, Greene exclaimed

> And now I ask could an Authority, besides that of The present Philosophy, ever support so absurd an Assertion as this, that Gold and consequently all other dense Substances here mention'd have more Pores than solid Parts? Why, we must bid adieu to our Senses, and to all our Notices communicated from thence, if we must acknowledge this for a truth.[50]

If the world was mostly empty space as the Newtonians asserted, we could not breath any more than an animal in an evacuated receiver. Nor could the expansive and contractive forces of bodies be communicated to other objects.

The transmission of light from a luminous source to the human eye provides a useful example. Greene did not believe in Newton's assertion that light particles travelled in straight lines through a vacuum in seven or eight minutes from the sun. Instead the expansive force of a luminous body was communicated to ether. Light was "manifestly owing to the Expansive Force of those Luminous Bodies, which, Striking upon Air or Aether, Produce the Sensations of a Vivid Yellow, or Orange in us; By air or Aether, I here, and all along, mean a certain subtile Medium, which is susceptible of these various Percussions from Bodies, and of

which all the World is Full."[51] Light particles did not leave the sun; instead the sun's expansive force was transferred through ether capable of communicating it. This expansive force when striking a prism was transformed into the colours of the spectrum and these colours depended on the various contractive forces in the prism it encountered.

Ether was also useful to explain the revolutions of the planets and gravitation. Greene believed that planetary motion was not the combination of a centripetal force and a centrifugal force. Experiments with a body revolving in a sling convinced him there was no centripetal force between the sun and planets; if such a force existed it should be sensible to the hand. If there was a centripetal force balanced by a centrifugal force "all that can follow will be only a perfect Quiescence."[52] Instead planetary motion was the product of the centrifugal or expansive force of the sun overcoming the contractive force of the planet. The sun's role as an agent of expansion explained why no centripetal force was evident between the sun and planet and its absence in the sling experiment. Greene claimed that the "Infinite and Almighty Agent, by Impressing this Force upon the Sun, Directs and Guides the Motion of the whole Solar System…..this Expansive Force of the Sun Diffuses and Disposes it self thro' the whole Ambient Plenum."[53] As the expansive force of the sun was transmitted through this ether so too was the contractive force of a planet. Such a force caused a regression in the same ether that resulted in a body descending toward the Earth.

Thus through this pliable ether all natural phenomena could be explained.

Greene's spiritualism

As the last quote suggests, Greene's works imply that God was intimately connected to nature in some way. The expansive force of the sun and light along with the plenum (composed of equal amounts of expansive and contractive forces) were agents through which God exercised His providence in the world. Attempts to link God closely to nature always ran the risk of making God equivalent to nature. The case of Toland and more notorious continental heretics like Spinoza illustrated such dangers. By equating force with matter Greene came dangerously close to pantheism. It appears that Greene recognized the potentially heterodox implications of his own thought. In a discussion of the expansive and contractive forces of the mind, Greene cautioned that when

> I Speak of the Expansive and Contractive Forces of the Mind, and assert the like Forces to belong to Bodies, I do not make Mind and Matter the same; I only Affirm, that they have Properties and Powers, which are Analogous, when the Beings, in which they Reside, are Perfectly Different.[54]

Despite this subtle distinction, it is apparent that the forces of inanimate nature, particularly those of the sun, light and fire had spiritual or divine significance for Greene. Greene's unorthodox defence of Anglican orthodoxy may partly explain the lack of support for his views. Certainly the mystic John Byrom's visit with Greene did not make him a convert to his philosophy; nor have I yet to find any circle of committed Greenians.

Greene certainly believed that his system provided a strong defence of religion. He thought his expansive and contractive forces in all their diversity provided proof of God's existence, providence and wisdom. These forces "which are in their own Nature Contrary to each other, yet they are so Disposed by the Infinite Wisdom and Intelligence of the Almighty and great Creator as to Produce

an Aequilibrium in the Whole, and an Harmony in all the Beings of the Universal System."[55] Opposing defenders of a vacuum like the ancient atomists and Newton, Greene asserted that the universe was infused with a spiritual plenum emanating from God; in support of this position he further declared that those ancients like Thales, Anaximenes, Anaximander, Anaxagoras, Plato, Aristotle and Zeno who "affirm'd a Plenum, might justly and consistently affirm a God, a Mind, and an infinite Intelligence, from whom all that Plenitude and Fullness of Being was deriv'd, who actuated and inform'd the Whole."[56] Greene thought his system best defended the deity's continuing providence by making God immanent in but not equivalent to nature.

What intellectual sources did Greene draw upon in his critiques of ancient atomists, modern corpuscular philosophers and Newton? At this point it will be useful to discuss three natural philosophic traditions in early modern Europe. Hugh Kearney over thirty years ago in *Science and change 1500-1700* identified three such traditions which, in my opinion, are useful for a classification of Greene's thought: the organic, the magical and the mechanist.[57] Inspired by Aristotle the organic tradition was anti-mechanist in spirit; according to this philosophy the universe operated like an organism and everything had a final cause or end. The magical tradition was closely linked to the Hermetic writings and to neo-Platonism. For Plato the material world was the lowest form of life. Neo-Platonists beginning with Plotinus believed the universe was full of spirit of forces (the sun in particular was a source of life) and governed by mathematical harmonies. The physical universe was merely the manifestation of the irradiation from the infinite mind (God). In contrast the mechanists led by Democritus,

Epicurius, Lucretius and Archimedes promoted a universe that operated according to fixed laws where spirit was absent.

In my opinion Greene's philosophy of expansive and contractive forces fits most nicely within the boundaries of neo-Platonism. In the special role that Greene assigned to the sun and light within his system, and his belief that the universe was alive with force and spirit, one can see elements of neo-Platonism in his thought. It is also possible that organic conceptions of the universe influenced his thinking, especially his notion that the expansive and contractive forces of bodies were in dynamic equilibrium. I would not describe Greene as a neo-Platonist per se, but only indicate the congruency between elements of his philosophy and neo-Platonist doctrines. What Greene was most opposed to was the mechanical philosophies of Epicurius and Lucretius.

What is most interesting then is Greene's association of Newton with the mechanical tradition. Historians have noted the influence of the Cambridge Platonists Henry More and Ralph Cudworth on Newton.[58] Certainly Newton's belief in attractive forces suggested anything but the dead and lifeless universe of the ancient atomists. But this is not how Greene interpreted matters. He believed that Newton's General Scholium to the second edition of the *Principia* had not provided conclusive proof for the existence of a God, but only that God

> Was a being, which was Imperator Universalis, or Lord Paramount to these Atoms, and guided and conducted them as he pleas'd; which is saying nothing at all in Proof of a God, but forming a Creature of our own Fancies, which we Set at the Head of our imaginary atoms.[59]

In Greene's opinion, Newtonian natural philosophy with its atoms and vacuum "would not allow it to acknowledge, that the Intelligence was an Anima Mundi, or had any Connection with Nature, or any Union with it."[60] While Greene recognized that the Newtonian deity did guide and conduct atoms, in his opinion

it was still a deity that resembled that found in Lucretius' poem *De rerum natura* where the Gods remained aloof from human affairs. Newton then became a symbol for mechanist materialism.

Greene avoided Spinozian pantheism by postulating a hierarchy of spirits and forces in nature. While God was connected to nature he was not equivalent to it. Nature in all her forms was derived from the divine essence, but nature was clearly dependent and subordinate to God. In Greene's works one sees his use of the concept of a great chain of being. He declared that there

> seems to be as much a Gradation of the Powers and Faculties of Intelligent Beings, down from the Almighty, thro' all the Orders of them, to Men, and from Men, thro' the Intermediate Species of Animals, to an Oyster, as there is a Variety of Measures in Extension, from Infinity to Nothing.[61]

Arthur Lovejoy has noted the popularity of the idea of a great chain of being in nature and its close links with neo-platonic thought. The belief that all beings were derived from God's emanation supported the notion of linear gradation in nature from the lowest forms of life to God.[62] Greene's postulation of intermediate spirits and forces fits nicely within this tradition and is similar to the attempts of neo-Platonists like More and Cudworth to avoid the materialism of Descartes and the pantheism of Spinoza by advancing intermediate spiritual forces connecting God and nature.[63]

One sees with Greene then an attempt to replace philosophies governed by matter in motion with a system composed entirely of forces or spirits. By speculating about the nature of matter in the queries to his *Opticks*, Newton could be linked to corpuscular mechanists such as Hobbes, Spinoza, Descartes and Locke. For Greene, Newton's hypotheses about the structure of matter were far too speculative; he sought instead to base his system on matters of fact – on what

he considered to be the self-evidential status of expansive and contractive forces – in an effort to out empiric the empiricists. The promotion of his philosophy and attacks on the corpuscular philosophy were complemented with a vigorous defence of scripture. Greene's natural philosophy can be interpreted as a High-Church alternative to the then dominant Lockean and Newtonian philosophies advanced by Whigs and heretics. As the next chapter will show, Greene was not alone in his association of Newtonianism with the corpuscular philosophy.

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[47] *Ibid.*, 290.
[48] *Ibid.*, 296.
[49] *Ibid.*, 410.
[50] *Ibid.*, 5.
[51] *Ibid.*, 303.
[52] *Ibid.*, 175.
[53] *Ibid.*, 176.
[54] *Ibid.*, 639.
[55] *Ibid.*, 416.
[56] *Ibid.*, 17.
[57] Hugh Kearney, *Science and change 1500-1700* (London, 1971), esp. chap. 1.
[58] See Rupert Hall, *Henry More and the scientific revolution* (Cambridge, 1996).
[59] Robert Greene, *op. cit.* (ref 6), 36.
[60] *Ibid.*, 36.
[61] *Ibid.*, 655.
[62] Arthur Lovejoy, *The great chain of being. A study in the history of an idea* (New York, Harper reprint, 1965), esp chaps, 2 & 6.
[63] For More and Cudworth see Rosalie L. Colie, *Light and enlightenment A study of the Cambridge Platonists and the Dutch Arminians* (Cambridge, 1957), esp chaps., 5 & 6.

George Berkeley and materialist heresy

One of the towering figures of modern philosophy, George Berkeley is often studied only in relation to the controversies and concerns of present philosophers. The political and religious context in which he wrote is regularly ignored. Too little attention is paid to the historical origins of his thought, too much to the strengths or weaknesses of his arguments concerning existence, perception and the nature of ideas. This chapter attempts to rescue Berkeley from the a-historical approach of philosophers (including most historians of philosophy) and restore him to the cultural history of ideas. By examining the idealist philosophy, most notably expressed in the *Principles of human knowledge* (1710) and *Three dialogues between Hylas and Philonous* (1713), in relation to Berkeley's other writings on politics, religion and natural philosophy, new light can be shed on the political and religious motivations for his thought and his opposition to Newton.

Like Greene, Berkeley attributed the religious scepticism and freethinking of his time to the speculations of corpuscular philosophers. In his opinion, philosophers, by distinguishing the real nature of things from their apparent nature, had involved philosophy in all sorts of absurdities, such as the belief in an invisible substratum of matter. By equating our perceptions or our ideas of things with reality (his famous doctrine of *esse est percipi*) Berkeley hoped to rid philosophy of all those speculative entities used to explain phenomena. Opposing Lockean abstract ideas and the primary/secondary quality distinction, he resisted efforts to explain the qualities of bodies – their colour, taste and smell, by their corpuscular structure. In addition, he believed all attempts to understand physical forces, like those evoked by Newtonians to explain gravitation, were equally

absurd. All knowledge was based on what we perceived; the causes of phenomena were attributed to God. Unlike Greene, Berkeley did not equate matter with force – that, in his opinion, would be tantamount to pantheism; but like Greene one sees the promotion of a sensationalist theory of knowledge or radical empiricism to counter the speculations of corpuscular philosophers.

Berkeley's opinion of Newton was somewhat ambiguous, but nonetheless critical. On the one hand he praised Newton for his discovery of the laws of nature in the *Principia* and his reluctance to speculate about the nature of attractive force; on the other hand Newton's speculations about the atomic structure of matter, attractive powers and material ethers in the *Opticks* alarmed him along with Newton's advocacy of absolute space, time, motion and infinitesimals. This tension regarding Newton is expressed in a series of letters between Berkeley and the American intellectual Samuel Johnson in 1729. In one letter Berkeley stated:

> The true use and end of Natural Philosophy is to explain the phenomena of nature; which is done by discovering the laws of nature, and reducing particular appearances to them. This is Sir Isaac Newton's method; and such method or design is not in the least inconsistent with the principles I lay down.[1]

However, Berkeley portrayed Newton very differently in a later letter:

> Sir Isaac Newton supposeth an absolute Space, different from relative, and consequent thereto; absolute Motion different from relative motion; and with all other mathematicians he supposeth the infinite divisibility of the finite parts of this absolute space; he also supposeth material bodies to drift therein. Now, though I do acknowledge Sir Isaac to have been an extraordinary man, and most profound mathematician, yet I cannot agree with him in these particulars.[2]

While Newton was praised for his mathematical analysis of the laws of nature in the *Principia*, his defence of absolute space, time and motion, along with the speculations in his *Opticks* of an externally existing matter composed of

imperceptible atoms and governed by attractive and repulsive forces, tied Newton to heterodox Arian Anglicans like Clarke and freethinkers or minute philosophers such as Toland and Collins, men who Berkeley spent a lifetime criticising. Much like Greene, Berkeley worried that Newton had fallen prey to the faulty speculations of corpuscular philosophers who elevated matter above spirit.

Above all Berkeley was anxious to defend God and His providence over the natural world. This lay at the root of the idealist philosophy of the *Principles* and *Three dialogues* and his defence of the Anglican establishment, especially religious mysteries like the Trinity. Corporeal agents could not effect change in the natural world; to the extent that Newton suggested this he could be associated with radical Whigs and freethinkers who believed that motion was essential to matter and denied the immortality of the soul. By limiting human knowledge to what was perceivable Berkeley banished from philosophical discourse the discussion of invisible powers and material ethers used by Cartesians and Newtonians to explain natural phenomena. When Berkeley finally did abandon the empiricism of his early philosophy in his final major work *Siris* (1744), introducing his own ethereal mechanism to explain the virtues of tar-water, he incorporated his ethereal theory within a defence of God's providence, at the same time attacking Newton's ether composed of self-active particles.

This chapter begins with an examination of Berkeley as a political and religious writer. An analysis of Berkeley's idealist philosophy, its relationship to his political and religious thought and Newton's writings will then ensue. Finally Berkeley's *Siris* will be studied in relation to the preceding discussion.

George Berkeley, Irish Tory High-Churchman

From his youth as an aspiring intellectual in Ireland until his death, George Berkeley was a passionate defender of Church and King. He was born outside the town of Kilkenny in 1685, and was from a well off Anglo-Irish family. Like Jonathan Swift his early education was at Kilkenny School; he would later enter Trinity College Dublin in 1700. A.A. Luce has described Berkeley as "a south county Conservative." He was "loyal to Crown and Church, and had a deal of the Tory in him; but he had the name of not having declared himself in party politics."[3] Berkeley clearly sympathized with the Tory and Anglo High-Church cause in England and Ireland, yet he always refrained from raising the party flag. He was comfortable in the company of Whigs as well as Tories; when he was in England he became acquaintances of Addison and Steele as well as Swift, Pope, Gay, Parnell, Prior and Arbuthnot. While he did not write in favour of a government administration, as Swift did in the *Examiner*, Berkeley's political and religious works and his correspondence reveal a man deeply opposed to the growth of religious freethinking and the threat to duly established religious and political order in the early eighteenth century.

While Berkeley was writing and promoting his idealist philosophy, he published works attacking freethinking and defending passive obedience. Berkeley scholars have often ignored the political and religious contexts in which he wrote.[4] Berkeley's *Passive obedience* (1712) and his series of essays in Steele's *Guardian* indicate that contemporary debates about political and

religious authority were upper-most in his mind at the time he composed and published his philosophical masterpieces, the *Principles* and *Three dialogues*.

In *Passive obedience* Berkeley echoed views common among Tories; he rejected contract theories of government, like those of Locke, and urged loyalty to the established sovereign even in extreme circumstances. According to him, the moral law of non-resistance was a divine law, as true and certain as the propositions in geometry:

> Neither of them [the laws of non-resistance or geometry] depends on circumstances or accidents, being at all times and in all places, without limitation or exception true. 'Thou shalt not resist the supreme civil power' is no less constant and unalterable a rule, for modelling the behavior of a subject toward the government, than 'multiply the height by half the base' is for measuring a triangle.[5]

Even oppressive governments should not be actively resisted; to allow such an option would lead to anarchy: "in case the oppression be insupportable, and the prospect of deliverance sure, whether rebellion may not be allowed of? I answer, by no means."[6] As God had instituted moral and natural laws, citizens were to live in harmony with those laws for society to flourish.

Berkeley's views on passive obedience reflect his support for the Tories in England and Ireland during the reign of Queen Anne. Commenting to John Percival about the political controversy surrounding Henry Sacheverall which led to the Tories sweeping to power in 1710, Berkeley stated that "I like indeed very well the events which his preaching may have brought about; for (if I may judge of such things) it seems to me the Government [governed before by Whigs] had been much too long in the hands of a party."[7] Here Berkeley was expressing his sympathy with the not uncommon stance of anti-party, anti-faction thinking common to many Tory critics of the Whig Junto. Berkeley's Toryism led him to be suspected of Jacobitism. In 1716 he was denied the living of St. Paul's Dublin

on account of his suspected sympathies toward the Stuarts. David Berman has even suggested that *Passive obedience* was a Jacobite tract designed to encourage a return of the Stuarts after Queen Anne's death.[8] Whether Berkeley was a Jacobite is a question that I will not attempt to answer. What is significant is the congruency between many of his views on church and state and those of Tory High-Churchmen in England and Ireland.

This is further apparent in Berkeley's essays in the *Guardian* that reveal his fear for the future of the Anglican establishment. While Atterbury and his supporters used Convocation to pursue heretics, such as Clarke and Whiston, Berkeley's favourite target was Anthony Collins. In early 1713 he wrote to Percival that there is "lately published a very bold and pernicious book entitled a *Discourse on free thinking*. I hear the printer of it is put into Newgate."[9] From the spring to the fall of that year he wrote numerous essays in the *Guardian* attacking freethinking, a term which Collins had introduced in his *Discourse*. In his *Guardian* papers Berkeley labelled freethinkers as 'minute philosophers' concerned about little and low things, as he would again in *Alciphron*, published a few decades later.[10] By promoting liberty of conscience freethinkers taught men to question the authority of the Anglican Church. They attempted to free the world from "the ties that religion imposeth on our minds, from the expectation of a future judgement, and from the terrors of a troubled mind."[11] By doing so they disrupted traditional pillars of the political and social order, and Berkeley further declared that they "were enemies to the peace and happiness of the world."[12] Religious heterodoxy was a forerunner of political radicalism, especially of contract theories of government promoted by Locke.

After George I came to power, Berkeley quickly became disillusioned with the Hanoverian regime. Although he ultimately sided with the Hanoverian Succession – that is, with stability and order rather than out and out divine succession – the Hanoverians tended to favour the Whigs, Low-Churchmen and the moneyed interest. Berkeley believed the growth of vanity, luxury and freethinking was linked to the financial revolution and rise to power of a new class of moneyed men intimately connected to the Whig government of Walpole. For Berkeley the speculative mania surrounding the South Sea fiasco symbolized the corruption and immorality of his age. In *An essay towards preventing the ruin of Great Britain* (1721) Berkeley stated that, while not the original evil or source of the nation's misfortunes, the South Sea affair was "the natural effect of those principles which for many years have been propagated with great industry."[13] Berkeley's statements echo those of his fellow Irishman Swift's critiques of financial projects and projectors in *Gulliver's travels*, and also reflect the anxieties of Tories such as Bolingbroke, Pope and Gay whose attacks on the expanding executive, placemen and the influence of moneyed men in Walpole's administration reflect a more general opposition to court interests.[14]

Distraught at the prevailing situation at home Berkeley turned his thoughts toward America. In 1724 he published a *Proposal for the better supplying of churches in our foreign plantations*. This work urged the building of a college in Bermuda to be called St. Paul's (the same name as the living that Berkeley was denied in Dublin on suspicion of Jacobitism) to train colonial youth and natives in the virtues of the Anglican religion. The college would then send qualified clergy back to the mainland. In 1728 Berkeley set sail for America with the promise of a grant of twenty thousand pounds from the British government for

his project. He waited nearly three years in Rhode Island for payment of the grant that was not ultimately forthcoming. Berkeley would blame Robert Walpole for the failure.[15]

Berkeley's alienation from Hanoverian society is apparent in his writings in the 1730s and 40s. Shortly after he returned to Britain from America he published works such as *Alciphron: or the minute philosopher* (1732) and the *Analyst; or a discourse addressed to an infidel mathematician* (1734) attacking freethinking and defending the Anglican Church. The former work not only attacked deists such as Toland, Collins and Tindal, but also Bernard Mandeville and the Earl of Shaftesbury. Berkeley's *Alciphron* asserted that minute philosophers like Epicureans worshipped matter and were governed by their passions. Holy Scripture and divine mysteries were defended against enemies of the clerical establishment. As Berkeley would later strongly claim in the *Analyst*, the mysteries of religion were no more unintelligible than the doctrines of mathematicians, promoters of obscure notions such as infinitesimals who were concerned about minute things.[16]

When Berkeley published his *Siris: a chain of philosophical reflections and inquiries concerning the virtues of tar-water* (1744) and offered is own ethereal mechanism to explain causation in the universe, he was writing very much as a Tory disaffected with the uses to which natural philosophy had been put by Whig intellectuals. In this sense, I agree with Marina Benjamin's claim that "*Siris* represents Berkeley's attempt to provide the High-Church with a Trinitarian natural philosophy."[17] The ethereal spirit in tar-water provided a vital link between God and his creation and offered a valuable counter to the thought of heretical freethinkers who believed motion was inherent in matter. For Berkeley

such a response was crucial in an age increasingly dominated by Whigs, Latitudinarians, religious nonconformists and the moneyed interest.

Berkeley's idealism and the defence of God's providence

Berkeley's idealist philosophy, as expressed in his *Principles of human knowledge* (1710) and *Three dialogues between Hylas and Philonous* (1713), represents an attempt to provide an alternative philosophy of knowledge and a stronger defence of God's existence and providence than the dominant corpuscular mechanical philosophies. As Berkeley wrote to Percival shortly after the publication of the *Principles*, the book was "designed to promote true knowledge and religion particularly in opposition to those philosophers who vent dangerous notions with regard to the existence of God and the natural immortality of the soul." [18] These philosophers included Descartes, Locke, Spinoza, Hobbes and Epicurus who believed in the corpuscular composition of matter, attempted to explain natural phenomena mechanistically in terms of matter in motion and in some cases equated extended substance with God. Berkeley's philosophy was opposed to corpuscular speculations or abstractions deviating from our perceptions and direct sensory evidence.

In Berkeley's *Philosophical commentaries* his dislike of the dominant corpuscular philosophies of his contemporaries is clear. The *Philosophical commentaries*, two notebooks written in 1707 and 1708, are good indicators of Berkeley's views just before the publication of his *Principles*. Berkeley complained that most philosophers

> with a supercilious Pride disdain the common single informations of sense. they grasp at Knowledge by sheaves and bundles ('tis well if catching at two

> much at once they hold nothing but emptyness and air). they in ye depths of their understanding Contemplate Abstract Ideas.[19]

The belief in an externally existing material substratum composed of corpuscles was linked in Berkeley's mind to materialist accounts of causation. He associated the fall of Adam with the rise of materialist philosophies: "ffall of Adam, rise of Idolatry, rise of Epicurism and Hobbism, dispute about divisibility of matter and expounded by material substances."[20] He claimed that Locke held dangerous opinions such as the infinity and eternity of space and the possibility of thinking matter; Hobbes and Spinoza had also made God an extended part of nature. Instead, Berkeley declared that my "Doctrines rightly understood all that Philosophy of Epicurus, Hobbs, Spinoza etc wch has been a Declared Enemy of Religion Comes to ye Ground."[21]

Berkeley's early opposition to the corpuscular philosophy, especially Locke's, had its roots in Ireland. His fears must be understood with reference to local contexts. As Greene was an isolated Tory at Clare Hall, the young Berkeley attended meetings of the Dublin Philosophical Society. Many of its leading members were Irish Whigs and advocates for Lockean philosophy. For example, William Molyneux dominated the Dublin intellectual scene, introduced the study of Lockean philosophy into Trinity College Dublin and was intimate with Irish commonwealthsmen such as Toland and Robert Molesworth.[22] When Berkeley attended meetings of the Dublin Philosophical Society in 1707-08, it was under the leadership of Molyneux's son Samuel. Instead of embracing Lockea n philosophy in its totality, however, Berkeley revolted against certain key elements of it such as Locke's theory of abstraction and language. Locke's claim that words must stand for clear and distinct ideas threatened to make concepts like the Trinity unintelligible and was especially dangerous in the hands of

freethinkers such as Toland.[23] Locke's theory of abstract ideas also lay behind the belief of an externally existing matter. New philosophical principles were needed to counter this threat, principles that would take Berkeley outside the mainstream of Irish philosophy.

Berkeley clearly saw himself as an innovator in philosophy, someone who was attempting to save philosophy from the perplexities and absurdities of current theories. He noted in the *Philosophical commentaries* that

> I am young, I am an upstart, I am a pretender, I am vain, very well. I shall Endeavour patiently to bear up under the most lessening, vilifying appellations the pride and rage of man can devise. But one thing, I know, I am not guilty of. I do not pin my faith on the sleeve of any great man. I act not out of prejudice and prepossession.[24]

Berkeley was anxious to make converts to his philosophy. He asked his good friend John Percival to get the opinion of his *Principles* from "some of your ingenious acquaintances who are thinking men addicted to the study of rational philosophy and mathematics."[25] Berkeley's *Principles* was shown to Clarke and Whiston both of whom rejected his immaterialism and ranked him with Malebranche and his English follower John Norris.[26] The early response to Berkeley's philosophy was somewhat muted in the early eighteenth century. The postulation of the non-existence of matter seemed absurd in a materialist age.

The root cause of Berkeley's opposition to an externally existing matter and the corpuscular philosophy lay in his rejection of abstract ideas, especially as promoted by Locke in his *Essay concerning human understanding*. Like Greene, Berkeley was opposed to any notion of ideas abstracted from sensory experience. At the beginning of the *Principles* Berkeley blamed abstract ideas for many of the unintelligible doctrines of philosophy in his day such as the belief in the existence of matter independent of perception.

> If we thoroughly examine this tenet, it will, perhaps, be found at bottom to depend on the doctrine of abstract ideas. For can there be a nicer strain of abstraction than to distinguish the existence of sensible objects from their being perceived, so as to conceive them existing unperceived.[27]

Berkeley believed the only ideas we could represent to ourselves were ideas of particular things we perceived, and thought the notion of primary and secondary qualities, common among corpuscular philosophers, were based on faulty abstractions of the mind. Our ideas of the primary qualities of bodies like extension and solidity could not be abstracted from secondary qualities like colour, smell and taste. Therefore, the secondary qualities of bodies could not be explained via the arrangement of its primary qualities, the figure and motion of corpuscles. Concepts such as absolute space, time and motion were also based on abstractions from sensory experience. Humans could not intelligibly conceive of space or motion exclusive of body.

Berkeley's solution to the problem of scepticism and materialism was simple but inspired; he declared that what humans perceived really exists. This involved a refutation of the distinction made by Locke and others between reality and perception and between primary and secondary qualities. Colours, smells and tastes were no less real than extension and solidity. In his *Principles* Berkeley introduced his important principle – that matter cannot exist independent of the mind or being perceived.

> For as to what is said of the absolute existence of unthinking things, without any relation to their being perceived, that is to me perfectly unintelligible. Their *esse is percipi*; nor is it possible they should have any existence out of the minds or thinking things which perceive them.[28]

If humans limited their enquiries about nature to the visible ideas of sensory experience all uncertain speculations about invisible corpuscles and other absurd ideas, such as the infinitesimals of mathematicians, would cease and a clear

foundation for knowledge be established. As Berkeley stated in the *Three dialogues*,

> it is my opinion that the real things are those very things I see, and feel, and perceive by my senses. These I know; and, finding they answer all the necessities and purposes of life, I have no reason to be solicitous about any other unknown beings.[29]

Berkeley's reduction of ideas to our sensations was very much rooted in his opposition to mechanical accounts of causation. By limiting philosophical discourse to the perceivable world he hoped to rid philosophy of materialist explanations for phenomena based on the arrangement of corpuscles or occult forces. He complained in his *Principles* that philosophers often mistakenly concluded the causes of properties to exist within a body:

> some have pretended to account for appearances by occult qualities; but of late they are mostly resolved into mechanical causes, to wit, the figure, motion, weight and suchlike qualities of insensible particles: whereas, in truth, there is no other agent or efficient cause than spirit.[30]

While most causal explanations followed the corpuscular model of Descartes and Locke in the late seventeenth century, Berkeley admitted that by 1710 the principle of Newtonian attraction was the great mechanical principle now in vogue, and he further noted dismissively "that a stone falls to the earth, or the sea swells toward the moon, may to some appear sufficiently explained thereby. But how are we enlightened by being told this is done by attraction?"[31] Our perceptions do not indicate the existence of any material causal agents such as corpuscles, subtle ethers or invisible powers whose arrangement and action are responsible for various natural phenomena

All that our sensations revealed was a succession of ideas, one following the other. While Berkeley admitted the existence of ideas of memory and imagination and allowed for abstraction in certain limited cases, the building

blocks of knowledge in his philosophy were formed from ideas representing particular things that were evident to the senses. These ideas were passive. According to him, active causal agency could only be attributed to spirit. The relationship between ideas did not imply a necessary relationship between cause and effect. Ideas were only signs of things to come, and our experience taught us that such and such ideas were attended with such and such effects. Like the French philosopher Malebranche, Berkeley was an occasionalist attributing causation directly to God and lesser spirits.[32] Philosophy could not determine corporeal causes; all it could do was discover an order or regularity in nature.

Berkeley believed that his philosophy gave sound evidence for the existence of God and His providence. Like Greene, he wished to offer a new foundation for knowledge to defend religion against the sceptical implications of belief in the existence of an invisible substratum of matter, notably evident in the philosophy of Locke and supported by Newton. Without sound principles of knowledge a secure foundation for natural religion was impossible. Illustrating God's providence was at the heart of his project. As David Berman has noted, God "is very much at the centre of Berkeley's philosophy, replacing matter as the cause and orderer of the physical world, which is only a succession of ideas produced in finite minds." [33] For Berkeley, the order and regularity of our ideas demonstrated divine design; this constancy reflected God's operation through uniform natural laws.

Berkeley expanded upon these themes in works of the 1730s like *Alciphron* and *The theory of vision or visual language* (1733). The regular succession of ideas indicated that God communicated to us through a language of vision. In the former work he declared that

> the proper objects of sight are light and colours, with their several shades and degrees; all which, being diversified and combined, form a language wonderfully adapted to suggest and exhibit to us the distances, figures, situations, dimensions and various qualities of tangible objects.[34]

Humans learned this language through experience, eventually understanding the connection between signs and things signified. For example, a blind man suddenly made to see would in time learn this language or the relationship between visual signs and tangible objects.

Berkeley believed that particular attributes of God such as His providence and wisdom could also be demonstrated through his philosophy. From our perceptions humans could infer the existence of God, as we could our soul from the motions of our own bodies:

> yet I do in the strictest sense behold and perceive by all my senses such signs and tokens, such effects and operations, as suggest, indicate, and demonstrate an invisible God, as certainly, and with the same evidence, at least, as any other signs perceived by sense do suggest to me the existence of your soul, spirit, or thinking principle.[35]

Unlike many High-Churchmen, Berkeley was firmly committed to rationalism in theology. As David Berman has indicated, knowledge of God is essentially scientific knowledge for Berkeley.[36] However, Berkeley's natural theology was based on an alternative foundation for knowledge, one differing fundamentally from that of English philosophers like Locke and Newton and which attempted, like Greene's natural philosophy, to counter deism by emphasising God's imminence in nature.

Along with Berkeley's promotion of natural theology, *Alciphron* was also accompanied with a strong defence of the authority of scripture, miracles and mysteries such as the Trinity against the attacks of freethinkers. The defence of the above cornerstones of Christian faith complemented Berkeley's promotion of his idealism and his attacks on the minute philosophers – those who reduced all

causation to material agents and ridiculed the authority of bishops. While natural religion was useful to prove God's attributes such as His wisdom and power, it had its limits. In the guise of the fictional character Crito, Berkeley stated,

> thus much is generally acknowledged, that there is a natural religion, which may be discovered and proved by the light of reason, to those who are capable of such proofs. But it must be withal acknowledged that precepts and oracles from heaven are incomparably better suited to popular improvement and the good of society than the reasonings of philosophers.[37]

While mysteries such as God's grace, the resurrection and the Trinity lay beyond natural religion they encouraged men and women to live holy lives and thus should be believed. It was certainly no more unreasonable to believe in the Trinity than the abstractions of the minute philosophers, men who postulated the existence of forces and subtle ethers. Indeed, for

> ought I see, that philosophers cannot be free from bias and prejudice, or be said to weigh things in an equal balance, who shall maintain the doctrine of force and reject that of grace, who shall admit the abstract idea of a triangle, and at the same time ridicule the Holy Trinity.[38]

In contrast freethinkers like Toland, Collins and Tindal rejected all religious tenets that were not based on clear and distinct ideas.

It was to defend religious mysteries against the unintelligible doctrines of mathematicians and natural philosophers that Berkeley published the *Analyst: or a discourse addressed to an infidel mathematician* in 1734. In this work Berkeley argued that the infinitesimals upon which both the fluxional calculus of Newton and differential calculus of Leibniz were based were no more comprehensible than the corpuscles of the materialists. Like corpuscles, infinitesimals were the product of abstraction. Thus infidel mathematicians such as Edmund Halley were not justified in rejecting religious mystery when the foundations for their own science were so weak.[39] In a series of queries appended to the end of the work,

Berkeley associated the corpuscularian, experimental and mathematical philosophies with the religious heresy of his day. He asked whether

> from this and other concurring causes the minds of speculative men have not been borne downward, to the debasing and stupefying the higher faculties? And whether we may not hence account for that prevailing narrowness and bigotry among many who pass for men of science, their incapacity for things moral, intellectual, or theological, their proneness to measure all truths by sense and experience of animal life.[40]

Those who promoted corpuscles, forces, ether, infinitesimals and hypotheses based on the erroneous doctrine of abstract ideas, were responsible for Britain's religious malaise, and Newton was guilty of just this.

Newton and the minute philosophers

Like Greene, Berkeley worried that Newton had adopted the methods and appropriated the ideas of corpuscular philosophers such as Hobbes, Spinoza, Descartes and Locke. He was also alarmed by Newton's suggestion that force was inherent in matter in the Latin *Optice*. Radical freethinkers then used these notions to deny the immortality of the soul and to equate nature with God. This may partly explain why Berkeley's criticisms of Newton were rarely directed specifically at him. Despite Berkeley's admiration for Newton's *Principia*, his speculations in the *Opticks* left him vulnerable to attack. While Greene saw Newton as continuing the tradition of Epicurus, Berkeley believed Newton had adopted many of the fundamental tenets of modern corpuscular philosophers. In the Latin *Optice* Newton made his belief in the atomic structure of matter, and its important role in accounting for the qualities of bodies clear, and combined these atoms with active principles or forces responsible for qualitative changes in bodies.[41] Later in the second English edition of the *Opticks* he would offer an

ethereal explanation for gravity. By inferring the external existence of atoms, forces and ethers from experiment and independent from immediate perception, Newton violated Berkeley's *esse est percipi* principle and appeared to give credence to materialist accounts of causation and sensation. Furthermore, his belief in absolute space and time were also based on abstractions from concrete experience and held much danger for religion.

At this point it will be useful to discuss Berkeley's treatise on the science of motion *De motu* in order to highlight the manner in which Newton and his followers had deviated from the proper sphere of physics as Berkeley defined it. Berkeley was quick to point out that the word attraction "was certainly introduced by Newton [in the *Principia*], not as a true, physical quality, but only as a mathematical hypothesis."[42] Berkeley had no problem with the use of the concept of attraction or force in a solely hypothetical or instrumentalist sense. However, the postulation of the real existence of imperceptible forces responsible for gravity lay outside the proper bounds of natural philosophy:

> it is not, however, in fact the business of physics or mechanics to establish efficient causes, but only the rules of impulsions or attractions, and, in a word, the laws of motions, and from the established laws to assign the solution, not the efficient cause, of particular phenomena.[43]

The real "efficient causes of the motions and existence of bodies or of corporeal attributes in no way belong to mechanics or experiment." These principles belonged to the province of theology and first philosophy that was "concerned with incorporeal things, with causes, truth and the existence of things."[44] At the end of this essay Berkeley urged natural philosophers to: "(1) to distinguish mathematical hypotheses from the natures of things; (2) to beware of abstractions; (3) to consider motion as something sensible, or at least imaginable; and to be content with relative measures."[45]

Berkeley's immaterialism is way beyond Newton's in its centring on intelligent perceiving spirit. From certain viewpoints, Newton himself was 'immaterialist', in that causal agency in nature is located in a non-material stratum of force, a post-mechanical conception allowing for theoretical and theological manoeuvre. However, Newton's conflation of force and matter in the queries threatened to diminish the role of spirit as both a causal and as a perceiving agent. This is apparent in Newton's theory of perception. While Berkeley viewed perception as an active process involving intelligent spirits, Newton explained it within the framework of mechanistic corpuscular theory. In the second English edition of the *Opticks*, Newton explained vision as the product of vibrations in the ether "excited in the bottom of the Eye by the Rays of Light, and propagated through the solid, pellucid and uniform Capillamenta of the optick Nerves into the place of Sensation."[46] Different vibrations excited various ideas, and the other four human senses could also be explained via the ether. Unlike Berkeley, Newton resorted to corpuscular and ethereal mechanisms to explain perception, placing less emphasis on the role of perceiving spirit in human understanding of the world and more on the activity of an externally existing matter.

It was in Berkeley's last major work *Siris* that he expressed his most distress with Newton's materialist conjectures. Berkeley owned copies of the 1704, 1706 and 1730 editions of the *Opticks*, and was well aware of Newton's speculations about gravity.[47] In this work he attacked Newton's attempt to explain gravity via ether that was highly elastic and infused with active principles of attraction and repulsion. Acutely aware of the changes Newton had made in the *Opticks* Berkeley noted "all the phenomena and properties of bodies, that were before

attributed to attraction upon later thoughts seem ascribed to this aether, together with the various attractions themselves."[48] In an illuminating statement he further declared:

> Sir Isaac Newton in his later thoughts seems (as was before observed) to have adopted somewhat not altogether foreign from this notion, ascribing that [gravity] to his elastic medium which Descartes did to his second element. But the great men of antiquity resolved gravity into the immediate action of an intelligent incorporeal being. To which also Sir Isaac Newton himself attests and subscribes; although he may perhaps sometimes forget himself in his manner of speaking of physical agents, which in a strict sense are none at all, and in supposing real forces to exist in bodies.[49]

Newton's description of his ether suggested that it could operate as a causal principle independent of spiritual agency. This blurring of the spiritual and the material smacked of Spinozism and the pantheism of John Toland, who made motion inherent in matter.

Even more troubling for Berkeley were the many Whig Newtonians such as Bryan Robinson, Stephan Hales and Jean Desaguliers who popularised the Newtonian ether from the 1730s. More importantly, these writers followed Newton in conflating the ether with active principles.[50] Active powers were illustrated in public experimental lectures by Newton's disciples such as Desaguliers and Whiston. Aided by experimental apparatus such as the electrical machine and the air pump, popular lecturers revealed the various natural powers and subtle ethers responsible for phenomena in their experiments on electricity, magnetism, light and heat.[51] Thus Newton's speculations on attractive force and ethers were given public exposure and used to support dangerous notions like thinking matter.

Newton not only deviated from *De motu* by his postulation of corpuscles, forces and ethers, his metaphysics of absolute space, time and motion were also based on abstractions from sensory perceptions and led to heresy. In the

Principles Berkeley spent considerable time criticising Newtonian absolutes and defending relative space, time and motion. According to Berkeley, the notions of relative space, time and motion were intelligible because they were defined in terms concrete particular experiences. Berkeley declared that one of the chief advantages of regarding space in strictly in relative terms was

> that we are freed from that dangerous dilemma, to which several who have employed their thoughts on that subject imagine themselves reduced viz of thinking either that Real Space is God, or else that there is something beside God which is eternal, uncreated, infinite, indivisible, immutable.[52]

Instead, Newton had made space absolute and to exist independent of God's creation. While he denied that God was actually extended space or that space was the literal sensorium of God, Newton believed that space was an attribute of the deity and the place where God governed His physical creation. This appeared to make God an extended physical part of nature and space eternal, a particularly dangerous notion since Spinoza had equated God and matter with extension.

Berkeley's reference to persons who "employed their thoughts on that subject" almost certainly included Samuel Clarke. In his Boyle lectures *On the being and attributes of God* (1704), given only two years before Clarke edited the Latin *Optice*, he declared that "The Supreme Being, because he is Infinite, must be every where present;" God "includes and surrounds every thing with his boundless Presence," indicating an intimate association between extended space and God.[53] Berkeley's eagerness to have his *Principles* read by Clarke and Whiston shortly after its publication in 1710 may reflect his concern with the religious dangers implicit in the concept of absolute space as advanced in the *Principia*, Latin *Optice* and Clarke's Boyle lectures. Berkeley clearly saw his philosophy as offering a timely response to entities such as absolute space, attractive powers and ethers abstracted from sensory experience.

Berkeley's ether

Given his earlier opposition to speculations about subtle ethers, Berkeley's *Siris* is a curious work. While criticising Newton's ether, Berkeley offered his own ethereal mechanism to account for natural phenomena. By speculating about imperceptible ethers Berkeley appears to have abandoned his *esse is percipi* principle. However, Berkeley's abandonment of the strict empiricism of his youth and middle years did not lead him to embrace materialism but rather a form of poetic immaterialism or spiritualism. Berkeley attempted to merge his ethereal hypothesis with the early idealist philosophy of the *Principles*. He continued to defend the non-existence of matter independent of perceiving mind or spirit; God continued to exercise His role as the one true and efficient cause in the universe. Furthermore, Berkeley's hypothetical ether was based on the Platonic doctrine of innate notions; it was a concept that was native to the intellect, only waiting to be excited by our perceptions of the visible world.

There has been much debate about whether *Siris* can be reconciled with Berkeley's earlier idealism. While there is little doubt that Berkeley's last major work engaged in those corpuscular hypotheses he had previously cautioned against, the extent to which such speculations can be accommodated to his *esse is percipi* principle has been vigourously disputed.[54] The problem is particularly perplexing given Berkeley's postulation of unperceivable ether while simultaneously defending elements of his early philosophy. What I will suggest is that Berkeley's willingness to speculate about ether, a hypothetical entity

philosophers could not perceive, reflects his desire to offer an alternative ethereal theory to that postulated by Newton and his followers.

Berkeley was probably led into such speculations by the heterodox uses of ethereal theories, as outlined above. While the purpose of the *Principles* and *Three dialogues* was to offer certain foundations for knowledge to battle religious and philosophical scepticism, *Siris* was written to counter the materialist ether theories of the Newtonians who had conflated the ether with active principles. Given the growing popularity of ether theories in the 1730s and 1740s Berkeley felt compelled to engage with natural philosophers on their own terms. Indeed, the period proceeding publication of Berkeley's *Siris* witnessed a reinterpretation of Newton's work, which incorporated Newton's ethereal speculations to explain phenomena such as electricity, fixed air and nervous sensation.[55] Heretofore Berkeley had believed that the best way to defend religion was to offer certain epistemological foundations for knowledge. By banning forces and corpuscles from his universe, he rendered materialist accounts of causation unnecessary. By 1744, however, Berkeley had decided to appropriate the speculative hypotheses of the minute philosophies for the purpose of defending orthodox religion, a strategy that, as we shall see, Roger North and John Hutchinson also adopted. Berkeley may have consoled himself with the fact that his ether, while presently unperceivable, might be visible in the future with the aid of microscopes.[56]

In addition, it is also likely that Berkeley's interest in the curative qualities of tar-water led him to speculate about those hidden virtues that had made it so beneficial. Ian Tipton has persuasively argued that Berkeley failed to recognise the potential medical uses of tar-water until the late 1730s. His interest in medical

matters was spurred by the outbreak of a smallpox epidemic in his diocese of Cloyne in 1740 and an Irish dysentery epidemic the following year.[57] Berkeley used tar-water to treat smallpox sufferers in his Irish parish with great success. It is reasonable to suspect that Berkeley's speculative hypotheses in *Siris* reflect his changing interests; he was less interested in establishing certain foundations for knowledge and more in offering natural explanations for phenomena, albeit ones that retained a primary role for God's providential action.

Instead of the Newtonian ether that was elastic, active and infused with repulsive force, Berkeley postulated the existence of subtle material ether that was subservient to and an instrument of God's will. Berkeley identified his ether with fire or the light of the sun while criticising Newton at the same time for distinguishing his ether from solar light. The ether was a heavenly instrument of God's providence. The deity was the supreme commander in the universe assisted by His subordinate material agent. Berkeley stated that the

> order and course of things, and the experiments we daily make, shew there is a Mind that governs and actuates the mundane system, as the proper real agent and cause; and that the inferior instrumental cause is pure aether, fire, or the substance of light.[58]

For the support of his ethereal hypothesis Berkeley drew upon the writings of Plato, Pythagoras and the Stoics. In Berkeley's ether one sees the combination of Stoic concepts of subtle pneuma with the neo-platonic emphasis on light and the spiritualization of nature. The ether stood on the upper rungs of a neo-platonic great chain of being which stretched from God to the lowest forms of animate and inanimate life; the ether emanated from the Deity but was subordinate to the Creator. Much like Greene's hierarchy of forces, Berkeley's postulation of ether was meant to uphold rather than diminish God's providence.

Berkeley justified the existence of the ether by recourse to the Platonic doctrine of notions. In the second edition of his *Principles* (1734) he made a crucial distinction between ideas and notions. While humans could not have ideas or perceive spirit we could have notions of it. This applied to his ether that lay beyond sensory perception and, as an entity close to the top of the great chain of being, had spiritual attributes. In *Siris* Berkeley stated that it is a

> maxim of the Platonic philosophy, that the soul of man was originally furnished with native inbred notions, and stands in need of sensible occasions, not absolutely for producing them, but only for awakening, rousing or exciting, into action what was already pre-existent, dormant and latent in the soul.[59]

Knowledge of the fiery ether was innate; it was the product of reasoning upon our sensory ideas – a process that excited inbred notions. This was a far cry from Newton's experimental method of grounding hypotheses on natural phenomena that existed independent of perception, and of arguing from effects to principles.[60] In *Siris* Berkeley cautioned against arguing from appearances to the natures of things. Such a method had led to the false postulation of attractive powers. Science consisted "not in the passive perceptions, but in the reasoning upon them."[61]

Berkeley's strong defence of reason and the intellect in natural philosophical inquiries is interesting. He had previously attempted to counter materialist explanations for phenomena by promoting a rigorous empiricism. What could not be perceived was banished from philosophical discourse, and the use of atoms, corpuscles, ethers and forces as explanatory mechanisms were abandoned. Instead, all causation was attributed directly to God. Despite their differences, Greene likewise advocated a similar strategy by promoting a sensationalist

epistemology. Both saw Newton as adopting the faulty methods and assumptions of corpuscular philosophers especially in the Queries of the *Opticks*. Berkeley in particular was alarmed with Newton's speculations on attractive force, especially as these could be interpreted to mean that force and motion were inherent in material bodies.

Yet Berkeley's *Siris* advanced a very different strategy. In this work Berkeley engaged in just those speculations he had cautioned against. When arguing for hypothetical mechanisms to explain phenomena he grounded knowledge of his causal mechanism on the reasoning intellect rather than on external appearances. Berkeley attempted to appropriate corpuscular hypotheses to defend religion while retaining his earlier opposition to the real existence of forces. As we shall see in the following chapters Roger North and John Hutchinson also used corpuscular contact theories of motion to argue against the existence of active powers in matter. In their works, opposition to attractive powers led to a lively critique of Newton's experimental method.

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Roger North and Newton's mob philosophy[1]

Roger North's criticisms of Newton were grounded in a very different intellectual tradition than Greene's or Berkeley's. An admirer of Descartes, North was a mechanical corpuscular philosopher. He believed the universe could be reduced to matter in motion and he opposed the introduction of Newtonian attractive powers into natural philosophy – this represented to him a revival of Aristotelian occult qualities. While Greene and Berkeley viewed Newton as a speculative atomist or corpuscular philosopher and sought to re-animate the universe with spirit, North saw in corpuscular contact action mechanisms a refuge from a world inhabited by mysterious spiritual powers and forces. For North the universe was not a source for knowledge about the deity and religion; such a mingling of the material with the spiritual had led to the promotion of dangerous notions such as attractive powers and thinking matter. Instead of banishing from natural philosophy discussions of imperceptible atoms and corpuscles -- as did Greene and Berkeley (pre-*Siris*) -- and promoting a rigorous empiricism, North's natural philosophy was highly influenced by Cartesian rationalism. From indisputable principles North believed probable hypotheses could be inferred about the causal mechanisms at work in the universe. Such a mechanist universe was not a threat to religion; rather it prevented God from being made equivalent to nature, a notion that led to pantheistic conceptions of the natural world.

Yet despite these very important differences with Greene and Berkeley, North identified Newton and his followers with the growth of Whiggery, Latitudinarianism and deism in the aftermath of the Glorious Revolution. For

North the popularity of Newton (the new Aristotle) in post-revolutionary England was synonymous with the triumph of the Whigs – with the victory of a philosophical and political sect that threatened England's Anglican establishment. In his opinion, this popularity was intimately associated with Newtonian experimentalism, with the empirical epistemological foundations of Newton's natural philosophy that endowed matter with attractive powers. As North wrote his many essays on natural philosophy he expressed the view that the Newtonian Revolution represented a counter-revolution, a return to the superstitious occult qualities of the scholastics that in turn engendered and justified political and religious radicalism. For him the Enlightenment of Newton was no Enlightenment.

Royalist man of the law

Roger North is primarily known through his biographies of his three brothers Francis, Dudley and John and his autobiography *Notes of me*. These works remained unpublished until after his death in 1734 and have been the subject of recent editions by Mary Chan and Peter Millard.[2] The North biographies reveal many interesting facets of Restoration political, economic, religious and intellectual life, especially since the North brothers were of different professions. Francis was a lawyer who in 1682 became Lord Keeper of the Great Seal. Dudley was a successful merchant in Turkey in the 1670s, but returned to England in 1680 and two years later was elected sheriff of London. John was a scholar. In 1672 he was made professor of Greek at Cambridge, while in 1677 he succeeded Isaac Barrow as master of Trinity College Cambridge. North wrote the

biographies largely to vindicate the honour of his royalist brothers from the malicious slanders of Whigs in the aftermath of the Glorious Revolution. The biographies, especially the life of Francis, reveal North's strong royalism and his increasing alienation from political life after the death of Charles II.

During the reigns of the Restoration Stuarts North held many prominent government positions. After studying at Jesus College Cambridge and then at the Middle Temple, he was aided in his legal career by Francis, a rising star in the English legal community in the 1670s. Francis was closely tied to the Stuart court, and with his help North was appointed to several important positions. In 1679 he was made by William Sancroft steward to the See of Canterbury; in 1682 he was made a member of the King's Council; in 1684 he became Solicitor-General to the Duke of York (the future James II); in 1685 he was appointed Solicitor-General to Queen Mary of Modena and a year later her Attorney-General, while by 1685 he was M.P. for Dunwich.[3] Thus North was at the centre of English political conflict in the 1680s. This was not a position he would cherish.

During the Restoration Francis and his younger brother defended monarchical power against those who wished to tamper with the line of succession and weaken the powers of the King legally established by law. Both men took a leading role in the protection of royal prerogative, resisting attempts to exclude the Catholic Duke of York from the throne during the Exclusion crisis. Francis believed that efforts to exclude the Duke from the throne were only a pretence to attack the present monarch: "if such a foundation were once laid, whatever importunity prevailed to gain it, there would be the same with very large increas, to obtein all the power of the government out of the king's hands, upon pretence

to fortifie the exclusion."[4] North was also a member of the Council of Prosecution in the trials against the Rye-House plotters, Lord Russell and Algernon Sidney.[5] North thought that Whig fanaticism could only be countered by appeals to the law.

North's position became much more precarious after the death of Charles II. Both he and his brother Francis supported the right of James II to rule, but as loyal Anglicans, they could not accept his attempts to establish complete equality for Catholics in defiance of the law as it then stood. North recognised that James II's England was heading into a serious political crisis driven by self-interested factions. He described the reformers of his age, the Whigs, as "the most vicious lewd and scandalous of all mankind."[6] Yet as the crisis surrounding James II rule reached a climax, North expressed the view that political society was generally immoral. His age "was the age of Tory and Whigg, the former were our freinds, and much addicted to the botle; the others were not wanting in that, but much exceeded their antagonists, in envy, hatred, malice, and all uncharitableness."[7] North joined "with the Church of England party to maintaine the laws and religion establisht" against James' Catholicising policies.[8] However, despite his reservations about royal policy, he remained loyal to the monarch and never could accept the legitimacy of the 1688 revolutionary settlement. After the revolution, he thought James should be declared incapable of ruling and that William and Mary should be declared regents for a limited time. North wanted to keep open the possibility of James' return and thus was not even willing to accept William as king *de facto*.[9]

Finding the Glorious Revolution not very glorious, North left London and devoted the remainder of his life to reading, writing and improving his country

estate at Rougham. Even before William triumphed in England, North's life was increasingly a solitary one. After Francis' death in 1685, he became more isolated, so that "if I have any happiness I thinck it is, that I can play, and trifle away my time by [my]self."[10] Under his careful guidance, his estate of Rougham became a beautiful place to live; it was a refuge from the political and religious passions of the time. In the words of Peter Millard, "living quietly at Rougham, doing what he could for his family and neighbours and, through his writings for society in general, he tried to make of his own mind, as well as of his estate, a place of order, usefulness and beauty."[11] Joining North at Rougham in 1696 was his wife Mary, the daughter of Sir Roger Gayer, a staunch Jacobite. Together they had seven children. North's son Montague edited his father's biographies for publication in the 1740s.

If Roger North had one passion in his life it was writing. In total his works fill some sixty-eight volumes, the majority of which are now in the British Library. North was a meticulous author. If he set his mind on a particular subject, such as natural philosophy, he would compose an essay on that subject; then he would rewrite that essay several times. It is not surprising such a careful person would publish only a tiny portion of his labours during his lifetime. Before his death in 1734, a very small portion of his work was printed: *Arguments and materials for a register of estates* (1698), *Relections on our common failings* (1701), *Reflections upon some passages in Mr. LeClerc's life of John Locke* (1711), *A discourse of fish and fishponds* (1713) and *The gentleman acomptant* (1714). However, North's biographies of his brothers, his own autobiography, his critical response to the Whig bishop White Kennett's *Complete history of England*, the *Examen*, and his *Discourse of the poor* were not published until after his death.[12]

Most of North's deliberations on architecture, music and natural philosophy have remained unpublished until recently.[13] One can only speculate why North failed to publish most of his work, but it appears that his essays, whether in politics or natural philosophy, would have difficulty finding a receptive audience amidst the dominant Whig, Low-Church culture of Hanoverian England.

A Roger North scholar is faced with the mass of undated manuscripts. While Peter Millard has developed a chronology for the development of North's biographies, Mary Chan and Jamie Kassler have put together a tentative chronology for North's undated manuscripts by comparing the type of paper he used with his dated correspondence.[14] It is clear that North's manuscripts were in a constant state of revision. This was due in part to his personality – he was insecure and obsessed with his imperfections. It was also due to changes in the English political, religious and scientific scene. North's manuscripts on natural philosophy are indicative of this. As Newtonian natural philosophy was established in England, he became absorbed with and alarmed by the philosophical and theological writings of Newton and his disciples.

Background and development of North's anti-Newtonianism

Scholars have largely ignored and or underestimated the historical significance of Roger North's opposition to Newton.[15] The precarious history of North's manuscripts on natural philosophy is best illustrated by examining the editorial history of the *Life of John*. A manuscript version of this biography written shortly before North's death included "A dissertation of the new and modern philosophy." This dissertation can be found in the British Library (B.M.

Add MSS 32514). Unfortunately this long essay was omitted from Montague North's and Augustus Jessopp's editions of the biography. Peter Millard, the most recent editor, also omitted the dissertation stating that whatever interest it possibly "might have for the historian of science, it bears absolutely no relation to the life."[16] North scholarship has primarily focused on his theory of biography and musical writings to the exclusion of his many essays on natural philosophy. Perhaps this is because scholars have not generally valued North's Cartesian sympathies and critiques of Newtonian natural philosophy. Indeed, when North commented to his nephew Philip Foley in 1706 that Newton should have stuck to mathematics and "let dabbling in physics alone," Jessopp commented in a footnote that: "But the word [physics] can hardly be what the writer intended, he must be referring to Newton's speculations on the Book of Daniel and the Revelation of St. John."[17] Jessopp, North's Victorian editor, got it wrong. North's comments reflect his concern that Newton's speculations in the Latin *Optice* had introduced dangerous notions such as occult attractive powers into philosophical discourse. Indeed, North's opposition to Newton effectively dates from this period.

Dating the time when North became a determined anti-Newtonian is no easy task as most of his papers are undated. However, the work of Mary Chan and Jamie Kassler has made it possible to construct a tentative chronology of North's developing thought.[18] By using the *Checklist* and through internal evidence it is possible to approximate the time when North wrote his virulent anti-Newtonian essays.

North's early experiences at Cambridge in the 1660s greatly influenced his view of Newton. Of the four anti-Newtonians of this thesis, North was most

directly influenced by a notable seventeenth century natural philosopher, namely René Descartes. In his autobiography North revealed that when a student at Cambridge he had read Descartes' works three times before he understood him: the "3d time my braines were inlightened, and I gained the notions of his vortixes, vapours, and striatas."[19] It appears that the study of Descartes appealed to the young North because his writings were considered forbidden fruit at the university.

> I found such a stirr about Des-cartes, some railing at him, and forbidding the reading him as if he had impugned the very gospel, and yet there was a generall inclination, especially of the brisk part of the university, to use him, which made me conclude there was somewhat extraordinary in him, which I was resolved to find out.[20]

Individuals opposed to Descartes at Restoration Cambridge included the Platonists Henry More and Ralph Cudworth who feared that the Cartesian mechanical universe excluded God from the cosmos.[21] This was a concern shared by other English and Irish intellectuals including Greene, Berkeley and Newton himself. While Descartes' controversial reputation may have initially attracted North to the study of his writings, in his later years North viewed Newtonian natural philosophy as heretical and aspects of Cartesian philosophy as providing a useful alternative to it.

After he matriculated at Cambridge in 1667, North became a convert to Descartes' philosophy of nature. North studied the *Discourse on method* and became convinced of the value of the Frenchman's method of philosophising.

> Nothing more gained on my judgement, as to his peice De Methodo, but the rule of not building upon doubts, but first to find out what is most clear, and thence as from a foundation proceed to other matters as farr as you can walk, with like clearness. Then for his principles, the shaking off qualitys, which term confesseth ignorance and reducing all things to longum, latum, and profundum. His notion of motion, as nothing in it self, but as there is regard to the stations and positions of other body. And then his laws of motion; all

> which are improvements introduct, I may say invented in philosophy by that great man.[22]

While North was not a slavish admirer of Descartes, he believed that the Frenchman offered the best method to follow. By the time North was first exposed to Newton's writings, he was a firm advocate of a plenum in nature, Descartes' vortical system of the heavens and the relativity of space, time and motion.

As one might expect North's earliest statements regarding Newton provide criticisms of his theories, but North's comments from the 1690s also reveal a man intrigued with Newton's discoveries. In North's autobiography written between 1693 and 1698, he made some interesting comments about Newton's controversial theory of light.[23] North stated that he admired Newton's hypothesis "as new and most exquisitely thought. Which is in short that light generally speaking is a blended mixture of all colours; and that these colours are the different effects of certein rays." These rays are not "refrangible to the same angle, but some to a greater and some less." However, he cautioned that "there still wants a phisicall solution of this hypothesis, without which, however plausible, it will not be admitted."[24] North's statements suggest a familiarity with Newton's paper on white light published in the *Philosophical transactions* of 1672, and were similar to the complaints aired by many of Newton's contemporaries such as Robert Hooke.[25] Hooke asserted that light was a wave or pulse and not a particle as Newton's paper implied; Newton had provided an unsatisfactory account of what light was. In response to Hooke, Newton claimed that he had no intention to determine what light was or offer a hypothetical explanation for colour, but only "show that defacto they [colours] are originall and immutable qualities of ye rays wch exhibit them."[26] North's comments

reflect a frustration with Newton's reluctance to speculate about the nature of light in the 1672 paper and foreshadow his opposition to Newton's *Optice*.

The same ambivalent tone toward Newton exists in one of North's earliest works on natural philosophy *Mechanick notes*. This essay was written in the 1690s and likely completed by 1698 along with the autobiography.[27] Revealing the influence of Descartes, North stated in the opening paragraph that his aim in this work was to "deduce a system of Mechanical philosophy from ye Most Indisputable principles and by ye clearest steps yt may be."[28] In *Mechanick notes* there are several references to Newton: at one stage North comments on Newton's belief in a vacuum while in another section he indicates the latter's commitment to the idea of absolute space, indicating North's familiarity with the *Principia* in the 1690s.[29] North specified his opposition to both views, yet these writings do not contain the bitter commentaries on Newton so characteristic of his later writings. Although North believed Newton was advancing false notions, he does not view Newton and his followers as adversaries to be challenged. Indeed, there are few references to Newton in this treatise from the 1690s.

This was to change over the next ten years. As with other critics of Newton, the turning point was the publication of the 1706 Latin *Optice* edited by Samuel Clarke. The mathematical content of the *Principia* (1687), along with Newton's refusal to speculate about the cause of gravity, may partly explain the lack of references to him in *Mechanick notes*. The speculative queries to the 1706 *Optice* with their postulation of attractive powers affixed to corpuscles, a vacuous universe and absolute space made Newton vulnerable to the charge of making motion inherent in matter and God a material being. Even worse for North, the queries to the Latin *Optice* represented a frontal assault on Cartesian natural

philosophy and method. Indeed, in this edition Newton strongly promoted his experimental or analytic method and contrasted this approach with Descartes' synthetic method. At the end of query 31 Newton unveiled his experimental programme:

> as in Mathematics, so in Natural Philosophy, the Investigation of difficult Things by the method of Analysis, ought ever to precede the Method of composition. This Analysis consists in making Experiments and Observations, and in drawing general conclusions from them by induction, and admitting of no Objections against the Conclusions, but such as are taken from Experiments, or other certain Truths. For hypotheses are not to be regarded in Experimental philosophy.[30]

In contrast, the synthetic method of Descartes argued from principles to effects and advanced hypotheses in accord with first principles. North considered Newton's attack on hypothetical mechanisms like the Cartesian ether as faulty. Furthermore, arguing from effects to principles led to the introduction of fantastic notions such as attractive powers that held much danger for established religion.

Evidence for a metamorphosis in North's stance vis-à-vis Newton can be found in correspondence that he engaged in with Clarke. Even before his involvement with the publication of the *Optice*, Clarke had had an important role in the popularisation of Newtonian natural philosophy in Britain. In 1697 he translated an edition of Jacques Rohault's Cartesian *Traité de physique* into Latin. As Clarke translated successive editions, he added Newtonian footnotes that attacked Cartesian vortices and a plenum. In the words of Robert Schofield, the 1702 translation represented a "substantial move toward a direct confrontation with Cartesianism, with notes added from the *Principia* to confute Rohault's text."[31] After the *Optice* was published in May 1706, North wrote a letter in November to Newton's young disciple. In response to an earlier letter of Clarke, North denied that there was any evidence of attractive powers in the universe: "I

deny that meer Astronomical observations prove any vires, for in that Immensity causes may be such as No observation can discover."[32] Further evidence for a change in North's stance toward Newton comes from the letter he wrote to his nephew Philip Foley a month later. In contrast to the more reserved statements of the 1690s, North declared that Newton "hath broached a sort of philosophy more occult than that of the Peripatetic school, and his aim, as I guess, is to sanctify all vulgar and natural prejudices in a philosophical dress, and to keep the world from looking further." [33] Like Leibniz, North feared that the Newtonians were regressing into Aristotelian occult qualities. By the end of 1706 he recognised Newton and his followers as an intellectual party or faction in philosophy that had to be challenged.

The publication of the 1706 *Optice* exposed Newtonian natural philosophy to increasing scrutiny. All of Roger North's virulent anti-Newtonian essays were written after its publication.[34] In these essays North made numerous references to the *Optice* and to Newton's claim that the natural philosopher should argue from effects to principles. There is considerable evidence that North was planning to write a comprehensive work on natural philosophy around the turn of the century. Indeed, we can now be sure that this goal was largely completed by the late 1720s.[35] Although, North's own views on natural philosophy do not significantly change from his earliest treatise *Mechanick notes* to his later writings (*Physica* and the "Dissertation on the new and modern philosophy), his writings on natural philosophy, from approximately 1706 until his death in 1734, largely reject the growing popularity of the new scientific orthodoxy of his day. North remained a Cartesian methodologist all his life. His desire to refute the writings of Newton and his followers after 1706 can be explained by his outright opposition to

Newton's experimental method which led to the false postulation of attractive powers and a vacuum. As Newtonian natural philosophy was established in eighteenth century England, he became absorbed with refuting the Newtonians.

Newtonian epistemology and mob philosophy

Essential to North's rejection of Newton's inductive or experimental method of the *Optice* was his concern that a natural philosophy arguing from effects to principles threatened to introduce false and popular notions into natural philosophy, such as attractive powers and a vacuum. According to North, even abstract notions like absolute space, time and motion had foundation in experience. For example, humans daily observed space all around them and had trouble conceiving its absence if all corporeal body was annihilated. North described such notions as vulgar or common. They were the product of foolishly arguing from the appearances of things to the true constitution of the universe without due philosophical reflection. What was even worse, Newton and his followers used these vulgar ideas to court popularity. In North's opinion, the Newtonians represented a philosophical faction or sect more concerned with the promotion of their own interests than with the truth; their experimentalism represented a form of social levelling that supported Whig fanaticism and religious enthusiasm.

Because the human mind was always susceptible to the influence of prejudice, North believed it was important to use our reason to distinguish fact from fiction. As he stated in the introductory paragraph of *Mechanick notes*, in order to deduce a system of mechanical philosophy from indisputable principles, one must lay

aside all prejudice "and candidely Examine all our knowledge. and distinguish certain truth, from uncertain opinion, and conjecture, and put a Mark upon ye former, and Reserve ye latter ffor More proof."[36] As this statement indicates, Descartes had much influence on North. Among Descartes' successes in natural philosophy North included "His Confuting the abuse of our senses In the foolish mistake of Qualitys, and clearing us from their prejudices." The French philosopher showed that errors are "Not in the sence, but that those Ever Informe Exactly true, and that It is our Judgmt, and Inferences from them that prove fals."[37] Arguing indiscriminately from effects to principles resulted in the introduction of false principles into nature.

However, it would be wrong to describe North as an orthodox Cartesian. Indeed, he rejected innate ideas (except the idea of God) and Descartes' famous dictum 'I think therefore I am': "Cartesius saying cogito, was mistaken, it being more proper to say, percipio Ergo sum."[38] North's natural philosophy was a curious blend of Cartesian rationalism and English empiricism. He believed that all knowledge came from sensory experience. Sensations travelled to a common sensorium where spirit and matter interacted and the mind carefully judged sensory impressions. North did not know where this sensorium lay: "this sensorium hath bin guessed but never found; It is not the heart, brain, nor glandula pinealis; but most probably somewhere about the brain."[39] While North described his natural philosophy as synthetic, his rejection of innate ideas makes it difficult to label his method as synthetic or analytic.[40]

Despite these differences, North was greatly influenced by Descartes' belief that explanations for phenomena (the effects of nature) should be based on first principles that were in turn grounded on clear and distinct ideas. North thought

that rationalist abstraction, in the Cartesian manner, saved raw empiricism from itself by refining sensory evidence before submitting it to judgement. Physical hypotheses so derived were thus rationally defensible. North believed Descartes' ethereal vortices offered credible explanations for gravity and planetary motion consistent with rationally derived truths, such as the congruence of spatial extension and body and the impossibility of a vacuum. Extended and impenetrable matter filling all space was thus the likely cause of gravity, and the particular mechanism of ethereal vortices could be observed in miniature form in whirlpools of water. For North hypotheses were necessary in natural philosophy due to the limits of the human senses. Even with the help of telescopes and microscopes humans could not penetrate the depths of the indistinguishable world that lay beyond human sense. While Greene's and Berkeley's idealist philosophy sought to eliminate discussions of hypothetical ethers from natural philosophy, North was actively engaged in these speculations. North thought Newton's attacks on Cartesian vortices in the *Optice*, and his goal to achieve certainty in the sciences through experiment, was a species of vanity, and worried that Newton's own hypotheses in the queries were full of vulgar errors.[41]

After 1706 North became increasingly alarmed with the promotion of Newtonian experimentalism, especially as a market for experimental lectures developed in early eighteenth century England.[42] Newtonians such as Desaguliers and Whiston, among many others, popularised the Newtonian doctrine of attractive powers, the particulate theory of light and a vacuum to a public audience. While the Tory Newtonians Gregory, Keill and Friend wrote mainly in Latin and taught their courses at university, the Whigs Desaguliers and Whiston wrote and lectured in English before audiences that included merchants, artisans,

seamen and traders. Whig Newtonians promoted the usefulness of natural philosophy in an era of rapid commercial venture, one that witnessed the rise of joint stock companies and the moneyed interest closely associated with the Whigs. Newtonian lecturers had more to do with the popularisation of Newtonian natural philosophy than the Royal Society itself.[43] Desaguliers moved to London in 1713 while Whiston embarked on a successful lecturing career in the capital after being expelled from Cambridge. Reflecting on his series of lecture courses in 1734, Desaguliers claimed that in London he had seen the

> Newtonian Philosophy so generally received among Persons of all Ranks and Professions, and even the Ladies, by the help of Experiments; that tho several ingenious Men have since that Time with great Success taught Experimental Philosophy in my manner, I have had as many Courses as I could possibly attend; the present course, which I am now engaged in, being the 121st since I began at Hart-Hall Oxford, in the Year 1710.[44]

Newtonian natural philosophy had become the rage of London. For North, Newton's popularity was particularly disturbing given Newton's followers connections to Exchange Alley and the Whig moneyed interest.

Through experiment Newtonian attractive powers and a vacuum could be popularised. An appeal to attraction became a popular explanation for natural phenomena in the early eighteenth century. In North's writings there are no direct references to Newton's highly elastic and active ether. Newton's ethereal speculations, first published in 1717, only became popular after his death, and North viewed Newton through the lens of the Latin *Optice* with its promotion of a vacuum, attractive powers acting at a distance and attacks on ethereal mechanisms, especially the Cartesian ether. With new experimental apparatus, such as the electrical machine and air pump, Newtonian natural philosophers could demonstrate these phenomena while refuting the notion of a Cartesian plenum before an inquisitive audience.[45]

North was acutely aware of the importance of experiment in the battles between Newtonians and their Cartesian opponents. He was highly critical of an experiment Desaguliers conducted to refute the plenists:

> He [Desaguliers] Erected divers Receivors of a cilindrick forme, to be Exhausted, so that the falling of bodys might be apparent to the Eye, and a ginny and a piece of paper let goe together, fell and toucht ye bottom together. Hence 2 Notes: 1. the Exhausted Receivor is a vacuum…..2. that Gold and paper are Equally heavy.[46]

North was sceptical that this experiment created a vacuum, believing a feather dropped in the cylinder during its fall would be resisted by the subtle matter still inside. North's criticisms of this experiment are likely in response to Desaguliers' demonstrations before the King and Princess of Wales at Hampton Court in September 1717 and later that year before the Royal Society. These experiments were published in the *Philosophical transactions* (Oct-Dec 1717), which also included an account of Desaguliers' experiment using both a piece of paper and a feather in 1716. When the feather and guinea reached the bottom at the same time, Desaguliers noted that several English plenists objected that the glass cylinders were not long enough to take account for the difference in fall.[47] Was North (or Greene and Hutchinson) one of the English plenists to whom Desaguliers referred? One can but speculate. Despite North's connections with members of the Royal Society during the Restoration such as Robert Hooke and Christopher Wren,[48] his Jacobite sympathies and fervent anti-Newtonianism make his presence at Desaguliers' experiments unlikely. However, his comments do clearly indicate the importance of experiment in the larger philosophical debates of the day.

In North's opinion, what was particularly dangerous about the experimental Newtonianism promoted in coffeehouses was that it was popular precisely

because it appealed to the common prejudices of men (those with vulgar or untutored minds) and was grounded on methods and assumptions common to the uneducated multitude. North worried that the public all too willingly accepted the sensationalist epistemological claims of Newton and his disciples. Vulgar minds prematurely elevated relatively unrefined, non-abstracted images taken in too raw a state from the animal senses to the level of philosophical truths. For example, humans incapable of philosophical abstraction falsely and commonly concluded that a vessel devoid of gross matter was actually empty space, and that space and time existed independent of matter. North complained that when "Men talk of Empty Space their Notion is but a chimera created by prejudice of sense, that so fills their Imagination; ffor the Image of Emptyness, as it is in our Sense they translate to nature."[49] This unfortunate "warping of philosophy towards vulgar prjudice hath a great advantage with ye Generality; and Such as are not practist Extraordinarily with abstract thinking."[50] He further scorned those who from "ye confusion of sence derive powers, and reall Essences, of wch wee have No Evidence" and were consequently poets instead of philosophers and appealed "rather to witt and Invention than to truth."[51] North's description of the Newtonians as poets or the vulgar is significant; it reflects his alarm with the power of experiment, especially the rhetorical use of the word attract, to deceive an audience. Attraction had become the new idol of the marketplace.

Newton appeared as a leader of a philosophical faction or sect, especially with Newton's ascendancy to the presidency of the Royal Society and the spread of popular Newtonian experimental lecturing. North opposed Newton's incorporation of vulgar doctrines into his natural philosophy, but he was also alarmed with Newton's fame and status. Newton's popularity and power within

the British philosophical community was so encompassing that North described Newton as the new Aristotle of science, and he often described Newton as the head of the attractive sect.[52] By promoting attractive powers Newton seemed to be reviving the occult qualities of Aristotle's disputing science of words. But worst of all Newton was a new scientific idol thus overturning the revolution in seventeenth century science led by Descartes and Bacon, the latter of whom, despite his empiricism, was praised by North for his efforts to liberate natural philosophy from intellectual authorities. Such an endeavour was one of the major goals of the early Royal Society and its members.[53] Instead North declared that Newton had actually

> overturned the foundation of our Royall society, vist Nullius In verba, To that Now wee find all our second, third and fourth rate philosophers allwais harping upon certain words, to wch he hath Given a credit Instead of any clear Notion of things as for Instance ye word Attraction.[54]

The Newtonian doctrine of attraction appealed to so many because it puts "words In their mouths and furnisheth answers to every demand, to wch they have nothing reasonable Els to Say: As ask a surgeon what makes bones; he answers, the parts attract one another."[55] As a science of popular words Newtonian natural philosophy gained much applause, but it did not help humans understand nature as it actually existed but instead only promoted fantastic and vulgar notions.

The factitious Newtonians represented a corrupt interest group. As they promoted their vulgar notions as an alternative to the truth, so too did the Whigs and their religious allies the Latitudinarians and religious dissenters advance their own agendas that, in North's opinion, violated the law. Like the political of religious fanatics of the Restoration, the Newtonians attempted to support their cause by appealing to the prejudices of the populace. While Greene's philosophy of expansive and contractive forces and the idealist philosophy of Berkeley

attacked philosophical abstractions as the root of heresy, North thought that Newton's and his followers' incapacity for such abstract reflection led to unorthodoxy. A man disillusioned with post-revolutionary England, North identified the popularity of Newton and his faction with the same kind of madness that had led to the overthrow of James II. Instead of conquering their prejudices and passions the Newtonians had submitted to them.

Newton and religious heterodoxy

Although North was concerned that the Anglican Church was in danger from Whigs, Latitudinarians, republicans and deists, it is interesting to note that his writings lack many references to religion. Millard states that "nowhere in his writings do we find an expression of a personal, meditative Christian spirituality such as was fairly common in his age."[56] In contrast to Greene and Berkeley, North did not wish to establish new principles of nature and knowledge that would provide external proofs for the existence of God and His providence, principles that could support a mystical view of the universe where spirit was predominant. For North the study of nature was not a primary source for religious knowledge, and he worried that discoursing about nature and God from the appearances of things could lead to dangerous notions such as thinking matter. North believed the spiritual and material worlds were separate. The spiritual realm was largely inaccessible through the exercise of reason and the study of nature alone. All religious knowledge depended on biblical revelation passed down through generations and was the province of faith.

Newton's analytic or experimental method was problematic to North when applied to religious matters, especially relating to questions of God's relationship with nature. North believed that Newton's conjectures about the role of God in the *Optice* and his declaration in the General Scholium that "to treat of God from phenomena is certainly part of natural philosophy,"[57] could have dangerous results. The doctrine of attractive powers was not only repugnant to North because it was a popular notion – it also suggested that motion was inherent in matter and that matter could think. Freethinkers such as the radical Whigs John Toland and Anthony Collins then used the idea of attraction at a distance to deny the immortality of the soul and to promote pantheistic views of nature. North recognised the pitfalls that Newtonian ideas and experimental method entailed for the Anglican establishment:

> to my-thinking, this (the idea that matter can think) should alarm ye gentlemen of ye attractive sect, shewing how dangerous their proceeding is, in affixing quallitys to matter, as attractent, propellent, and centripetall, and ye like, least it be said, that it is from thought (in matter) that such quallitys proceed, and so deliver up ye cause of all incorporeall agents and powers.[58]

In a similar vein North declared that the "Atheists will have it [body] thinkable, the chemists to be saline, and the Attraction men to have vires."[59] Newtonian attractive powers illustrated the risks of discoursing about God from the appearances of things.

Even greater perils resulted over Newton's discussions about the nature and attributes of God in the *Optice* and in the General Scholium. In these works Newton portrayed a picture of a strong and united God with absolute dominion over His creation and suggested that God was indivisible and the holy Trinity false. The General Scholium was especially subject to anti-Trinitarian readings throughout the eighteenth century. As Steven Snobelen has argued, Newton's

claim that the word 'God' was a relative term, obtaining its meaning by reference to dominion and power rather than essence, had not only Arian but Socinian overtones. [60] Newton's statement in the *Optice* that space was the divine sensorium also left him open to the charge that he was making God a physical part of nature. This was a concern that Leibniz expressed in his correspondence with Clarke and that Berkeley also shared. North was no less concerned about the heretical consequences of Newton's doctrine of absolute space and time:

> the reality of space one would Guess they held that time and space were reall and necessary beings, wch God himself could not destroy or annihilate, but they must be coequal with himself, as If they were part of his very Essence.[61]

For North such false notions regarding God and His attributes were the product of the intrusion of experimental philosophy and Newtonian metaphysics into religion. While at one level Newtonian epistemology implied that matter could think, at another it gave credence to the belief in a universe composed of mainly empty space, and space as a necessary being coequal with God.

Given North's alarm about the Trinitarian controversy and Newton's promotion of absolute space and time, it is not surprising that he corresponded with Clarke on these matters. After their initial series of letters in 1706, the correspondence continued after the publication of Clarke's *Scripture doctrine of the Trinity* in 1712. North was asked by Clarke to comment on the work, indicating his respect for North as a scholar. In his answer of February 1713, North criticised Clarke's attempts to subject knowledge of mysteries such as the Trinity to the dictates of reason:

> that any person should interpose his litigating talent in refining and cavilling about formes and expressions concerning the devine Nature, as have bin used of ancient time in the Christian church, under pretence of modifying religious misterys to square them to our groveling capacities, or experiences of materiality: and especially that of the Holy Trinity, a subject that is extra, or rather supra to all humane thought or tyrall.[62]

Belief in the holy Trinity stood upon faith in the veracity of the scriptures, and not upon our reasoning on the effects of nature or metaphysical speculations. North showed his reply to his non-juring friend George Hickes who concurred that the Newtonian philosophy had made many Anglican divines Arians and deists.[63]

North's scepticism about the ability of humans to comprehend the miraculous is also revealed in a letter he sent to a friend about observations of a spectacle observed in the night sky on March 6, 1716.[64] The letter reveals North's doubt that human reason could explain such an unusual event. While North could not refrain from making his own speculations about the cause of the night-lights of March 6, described by contemporaries as an aurora borealis, he lashed out against those who promoted their doctrines with too much confidence:

> I may with confidence affirme, that no man can give a just physicall account of it, that is what ye luminous matter was, whence derived, and how wrought upon to lighten In this manner? Ffor ye seat as well as the substance of it was certainly beyond the reach of all our Experiment of sense of knowledge. And those who prtend to solve it let them set what price they pleas upon their doctrine, are no better than Mountebanks that give out upon stages strange Nostrums and Cures.[65]

North further criticised those who by "lectures, discourses, advertisemts etc goe about to obviate the Religious and moral applications of this very Extraordinary spectacle."[66] For North the light spectacle of March 6 was a miraculous event and a warning to the wicked of God's power. Natural philosophers who emphasised how common an occurrence it was took the mystery out of nature.

North's complaint of those who attempted to provide explanations for such an event is a clear reference to Whiston. Between March 6 and North's letter a month later, Whiston gave numerous lectures at Button's coffee house, the Marine coffee house and at York Buildings that were advertised to explain the

phenomena of early March.[67] A decade earlier Whiston had declared in his *New theory of the earth* (1696) that meteors, exhalations, and streams in the atmosphere would precede the end of the world, and his later lectures made an association between the aurora of 1716 and the upcoming apocalypse.[68] As previously noted, Whiston used Newton's theory of comets to provide mechanistic explanations for the biblical flood and the future millennium, and was the target of much ridicule among Tory natural philosophers and satirists.[69] While Tory Newtonians like Keill disassociated Newton from such theorising, North thought that world-making, anti-Trinitarianism and other heresies were intimately associated with Newtonian natural philosophy. Indeed, in his letter to Philip Foley of 1706, the same letter where North expressed disdain that Newton was regressing toward Aristotelianism, he described Whiston as a vile apocalyptic geometer.[70]

Unlike Newton, North did not see the external world as an important source of religious knowledge. The regularity of the motions of heavenly bodies might be suggestive of divine design, but too often such arguments could be turned on their head by deists, sceptics and atheists to question orthodox Anglican doctrine and venture into dangerous and presumptuous speculations about biblical history. This was the theme of North's essay "Philosofye not demonstrative of religion." Instead of providing proofs for the existence of God by studying nature, North claimed that humans had an intuitive knowledge of God from the first moments of life: a new born baby was quickly supplied with "an Idea of want, that is of Defect or Imperfection; Joined with an opinion that there is a power or means that can administer help."[71] Our notion of God was not innate – it was not implanted in our soul. However, this idea was so immediate upon our first

perceptions in the world that for practical purposes North described the idea of God as innate.[72] The fact that all societies on earth practised a form of religion confirmed this belief.

In his rejection of natural theology promoted by Newtonians and Newton's opponents such as Greene and Berkeley, North revealed his scepticism that natural theology could co-exist in a harmonious relationship with revealed religion. Like his non-juring correspondent George Hickes, North was deeply concerned about the heterodox uses of reason and natural philosophy. North's solution was not to reorganise knowledge (as did Greene and Berkeley) on new principles to provide a stronger defence of God and His providence. Instead North found solace in Descartes' dualism – the separation of the spiritual and material worlds. As North declared, there was "no true knowledge in ye world but of things naturall, Religion Not Capable of adequate knowledge is faith."[73] Discoursing about God from the appearances of things led to the questioning of the Anglican Church established by law. As the guarantor of order in society, the Church of England had to be submitted to with an implicit faith.

While North wrote in quiet isolation at Rougham, a certain image of the Newtonian emerged in his mind. North's disillusionment with British post-revolutionary political and religious society was also directed toward the Newtonian scientific establishment, an authority that North increasingly distanced himself from after 1688, spending most of his time writing, improving his estate and providing legal advise to friends and neighbours. As North was unwilling to submit to the new political and religious orthodoxies of his day so too was he averse to follow new trends in natural philosophy after 1687. North's

early exposure to and admiration for Descartes meant that possibilities for serious disagreement existed from the 1690s, but these differences became exacerbated with the publication of the 1706 Latin *Optice*, the entanglement of Clarke and Whiston in Trinitarian controversies, and the rise of Newton's popularity and power in both the Royal Society and the public sphere. The Newtonians appeared very much as part of the Whig Low-Church establishment that emerged, especially after 1715. North's retreat from political society after 1688 also involved a departure from active involvement with the scientific establishment. Instead of a universe activated by powers, North saw in Cartesian mechanism a refuge from the fanaticism of his age. As we shall see in the next chapter, John Hutchinson's biblically based cosmology emerged from similar fears.

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[29] *Ibid.*, f. 91 & f. 98.
[30] Isaac Newton, *Opticks*, ed. E.T. Whittaker (New York, Dover Reprint, 1979), 404.
[31] Robert Schofield, *Mechanism and materialism. British natural philosophy in an age of reason* (Princeton, 1970), 26. While Clarke's 1697 edition failed to challenge Cartesian theories, Clarke's 1702 and 1710 translations were much more confrontational. The latter edition incorporated used Newton's *Opticks* to attacks Descartes. For a good summary of Clarke's editorial additions see Michael A. Hoskin, " 'Mining all within'. Clarke's notes to Rohault's *Traite de physique*," *Thomist*, (1961), 217-27.
[32] B.M. Add. MSS, 32546, "Ansr to a letter of Mr. Clerck," f. 280v. Clarke had originally written to North on June 25, 1706.
[33] Roger North, *op. cit.* (ref 17), iii, 255.
[34] This is confirmed by internal evidence and Chan and Kassler's *Checklist*. According to the *Checklist* most of North's writings on natural philosophy found in B.M. Add.

MSS 32514, 32544, 32545, 32546, 32548 and 32549 are on paper that North used to compose essays after 1706.

[35] In his autobiography North stated that "my great aim hath bin at a system of nature, upon the Cartesian or rather mechanicall principles." Roger North, *op. cit.* (ref 2), *Notes*....., 96. Similar statements were made in *Mechanick Notes*. Also see B.M. Add. MSS, 32546, "Method Regulated," ff. 1-4. For North's works of the 1720s see his *Physica* B.M. Add. MSS 32544. This manuscript is in his son Montagu's hand indicating perhaps that Montagu was preparing it for publication.

[36] B.M. Add. MSS, 32540, *Mechanick Notes*, f. 82.

[37] B.M. Add. MSS, 32546, "Authoritys," f. 215v.

[38] B.M. Add. MSS, 32549, "Objections to These Theoremata," f. 99.

[39] B.M. Add. MSS, 32549, "Essay on ye Reciprocall forces of Body and Spirit Influencing Each other," f. 80.

[40] B.M. Add. MSS, 32514, "A Dissertation of the new and modern philosofye," f. 122v. Korsten, *op. cit.* (ref 3), 35 claims that North cannot be classified into either the synthetic or analytic camp.

[41] For important comments in this respect see John Friesen, *op. cit.* (ref 1), esp chap 2.

[42] Larry Stewart, *The rise of public science: rhetoric, technology and natural philosophy in Newtonian Britain, 1660-1750* (Cambridge, 1992).

[43] See Larry Stewart, "Other centers of calculation, or, where the Royal Society didn't count: commerce, coffee-houses and natural philosophy in early modern London," *British journal for the history of science*, xxxii (1999), 133-53.

[44] Jean T. Desaguliers, *A course of experimental philosophy* (London, 1734-44), i, pref. vi

[45] For an example of such an experimental course see William Whiston, *A course of mechanical, magnetical, optical, hydrostatical and pneumatical experiments; to be performed by Francis Hauksbee, and the explanatory lectures read by William Whiston* (London, 1713).

[46] B.M. Add. MSS, 32548, "Elater and Vibration Vacuum," f. 122.

[47] An account of these experiments can be found in Desaguliers' "An Account of an Experiment to prove an interspers'd Vacuum," in *Philosophical Transactions* [Oct-Dec 1717] (New York, Johnson and Kraus Reprint, 1963), xxx, 717-720.

[48] F.J.M. Korsten, *op. cit.* (ref 3), 13.

[49] B.M. Add. MSS, 32545 "Phisicks," f. 35.

[50] *Ibid.*, f. 36.

[51] B.M. Add. MSS, 32548, "Of Human Capacity," f. 114.

[52] B.M. Add. MSS, 32544 "Physica," f. 260.

[53] For an excellent article on the goals of Restoration natural philosophers to replace the authority of Aristotle's texts with a new science based on the observations of individual scientists see Peter Dear's, "Totius in verba: rhetoric and authority in the early Royal Society," *Isis*, lxxvi (1985), 145-161.

[54] B.M. Add. MSS, 32548, "Philosofy of Cartes and Newton," f. 42.

[55] B.M. Add. MSS, 32514, "A Dissertation on the New and Modern Philosofye," § 11.

[56] Roger North, *op. cit.* (ref 2), *Notes*....., 39.

[57] Isaac Newton, *Principia*, eds. I. Bernard Cohen & Anne Whitman (Berkeley, 1999), 943. The 1713 edition of the *Principia* reads experimental philosophy and not natural philosophy.

[58] B.M. Add. MSS, 32544, *Physica*, f. 260.

[59] B.M. Add. MSS, 32549, "An Answer to.....", f. 83.

[60] Steven Snobelen, "Isaac Newton, heretic: the strategies of a Nicodemite," *British journal for the history of science*, xxxii (1999), 381-419, pp. 406-7. Also see Larry Stewart, "Seeing through the scholium: religion and reading Newton in the eighteenth century," *History of science* xxxiv (1996), 123-65.

[61] B.M. Add. MSS, 32548, "Of Naturall powers, and Rules of Motion," f. 84.
[62] Quoted in Roger North, *op. cit.* (ref 2), *Notes*....., 18.
[63] Larry Stewart, *op. cit.* (ref 15), 53-72, p. 65.
[64] There are two copies of this letter: B.M. Add. MSS, 32546, "to Mr.," ff. 124-33v and ff. 134-41. The second letter is in the hand of Ambrose Pimlowe vicar of Rougham 1710-23. Unfortunately the letter does not indicate to whom North is writing.
[65] B.M. Add. MSS, 32546, "To Mr.," ff. 126-26v.
[66] *Ibid*., f. 132.
[67] See *Daily courant*, Mar 9, 15 & 16th, 1716.
[68] William Whiston, *A new theory of the earth* (New York, Arno Press Reprint, 1978), 211.
[69] A good discussion of the Tory wits and their relationship to Whiston can be found in G.S. Rousseau, "Wicked Whiston and the Scriblerians: another ancients-modern controversy," *Studies in eighteenth century culture*, xvii (1987), 17-44.
[70] See note 33.
[71] B.M. Add. MSS, 32548, "Philosofye not demonstrative of Religion," f. 145.
[72] *Ibid*., f. 145-45v.
[73] B.M. Add. MSS, 32549, "The Infelicitys of Naturall Philosophy," f. 108v.

John Hutchinson, mechanism and the defence of political and religious hierarchy

Of the four anti-Newtonians of this study John Hutchinson's opposition to Newton has received the most examination by historians of science. This is due to Hutchinson's influence on several intellectuals in mid to late eighteenth century England such as Robert Spearman, Julius Bate, Alexander Stopford Catcott, Duncan Forbes, William Jones and George Horne.[1] These men used Hutchinson's method of biblical interpretation and scriptural cosmology to defend revelation and the Anglican establishment against the attacks of deists and religious sceptics. In the case of the Oxford High-Churchmen Jones and Horne, Hutchinson's ideas were useful to battle heretical ideas emanating from France in the 1790s. However, less attention has been paid to Hutchinson's natural philosophy and its relationship to his political and religious views.[2] This chapter represents an attempt to address these issues.

There are interesting similarities between Hutchinson and North. Like North, Hutchinson proposed a mechanical universe operating according to contact action as a refuge from a world where force or spirit was immanent. He believed that Newton's postulation of attractive forces had resulted in materialist explanations of gravity by making motion essential to matter and nature equivalent to God. These errors were the product of grounding all knowledge of nature and religion upon sensory evidence. While the senses were important vehicles for obtaining knowledge, and experiment played a vital role in his natural philosophy, Hutchinson believed this knowledge had to be supplemented and guided by alternative sources, especially the bible.

Whereas North retreated to certain natural principles based on clear and distinct ideas that were known to the carefully reasoning mind, Hutchinson believed a proper interpretation of the bible would yield true natural philosophy. Hutchinson thought Jewish rabbis had corrupted the pure original Hebrew text of scripture through the introduction of points or vowels into the biblical narrative.[3] Through a correct reading of the original Hebrew scripture composed solely of consonants and shorn of the imperfections of contemporary biblical texts, knowledge of the hidden mechanical agents at work in the universe could be known. These agents with their three modifications – fire, light and spirit (analogous to the three persons of the Trinity) – were responsible for all natural phenomena. They represented God's instruments, exercising His will in the cosmos, and were subservient and separate from God who was the first Creator and mover of matter. As with North, one sees a strategy of countering pantheist doctrines by emphasising God's independence from His material creation, a tactic very different from Greene's natural philosophy and Berkeley's idealism which attacked mechanical corpuscular explanations by emphasising God's immanence. For Hutchinson, the book of nature was not a sufficient source for knowledge of the mysteries of nature or religion. He feared that Newtonianism struck a blow at the heart of the Anglican religious establishment promoting a religious and political radicalism that endangered the ecclesiastical and landed establishment in England.

Intellectual background

Like Greene and North the details of Hutchinson's life are sparse.[4] He was born in Spennythorn, a small village about a mile distant from Midlam, Yorkshire, in 1674 and was trained to be a steward. After serving in that capacity for the Earl of Scarborough he entered the service of the Duke of Somerset, Charles Seymour. While in London to manage a suit between the Duke and Lord Wharton, he met John Woodward, a man who would have a huge influence on his subsequent interests and development as a natural philosopher. From 1724 until his death in 1737 Hutchinson wrote many works that defended Moses and his own biblically based cosmology, and was aided in this task by Somerset who provided him with a house and an annual salary to pursue his writings. Hutchinson then "gave himself up entirely to a studious and sedentary life."[5] The image that emerges of Hutchinson – as of Greene, Berkeley and North – is of an opinionated and somewhat isolated original thinker who in his effort to counter the deism and atheism of his age turned against the scientific establishment exemplified in the figure of Newton.

Hutchinson's early willingness to criticize prevailing scientific orthodoxies is evident from his autobiography placed at the end of his *A treatise of power: essential and mechanical*. In this personal account of his own intellectual development Hutchinson states that he became aware of the material agents responsible for the mechanical operations in the universe through his early geological inquiries. Shortly before Newton became president of the Royal

Society in 1703 Hutchinson went to London and met several fellows. He stated that

> I soon found by their Questions, and their Reception of my Answers, and more fully by Conversations, inter al many with our Author [Newton], and lastly more plainly by reading their Books, that their Notion of the State and Situation of Things, and mine from what I had seen and observed, were vastly different, and the agents or causes directly opposite.[6]

At approximately this time he met John Woodward. Like Hutchinson, Woodward had an independent streak. His temper and vanity often led him into conflicts with leading men of the Royal Society, such as Hans Sloane. Joseph Levine has described Hutchinson as being as "opinionated and ornery as Woodward."[7]

The two men soon entered into a fruitful partnership. Hutchinson was intrigued by Woodward's attempts in his *Natural history of the earth* (1695) to provide a defence of the Mosaic history through his geological studies. Unlike Burnet's and Whiston's scepticism of scripture's ability to provide an exact philosophical account of the creation and the flood, Woodward thought Genesis could be interpreted literally to account for the early history of the earth. While Hutchinson opposed Burnet's and Whiston's theories, he was enthusiastic about Woodward's attempts to defend Moses. To this effect, Hutchinson made observations on geological strata and collected fossils for Woodward on his tours of England and Wales between 1702 and 1706. Woodward obtained Hutchinson's observations in order to write his *magnum opus*, a book defending the Mosaic history of creation.

However, this work was not published leading to a split between the two men. Hutchinson became furious with Woodward when he discovered, after many years of working for him, that Woodward had not even begun the proposed

project. Regarding Woodward's failure to write and publish his *magnum opus*, Hutchinson's biographer relates:

> This the Doctor engaged to draw up, but seems never to have had any real intention of doing, only designing to make this a pretence to engage Mr. Hutchinson more earnestly in collecting mineral materials, and at last of getting the whole collection into his possession. And the event justifies the suspicion.[8]

Disappointed by his colleague's inactivity, Hutchinson embarked on his own project to defend Moses. He devoted much of the remainder of his life to defending revelation against the attacks of enemies of the Anglican establishment.

Hutchinson's eagerness to defend scripture against the attacks of freethinkers is symptomatic of the worries among High-Church divines of the dangers that a solely reason based religion posed for the Anglican establishment. His writings criticising religious freethinkers and dissenters hardly indicate a willingness to tolerate opinions deviating from Anglican orthodoxy. Hutchinson's writings supported theological tenets that High-Church divines believed were at the core of Christianity. As Chris Wilde has noted:

> these tenets can be summarized in one word – Augustinianism. In this interpretation of Christianity central importance is given to the doctrine of original sin and redemption. Because of Adam's sin in setting his own will against that of the Creator, he and his heirs have been separated from God. Since man in his fallen state is unable to help himself, God has acted in Christ to redeem his fallen creatures. To this man can only respond with faith, by surrendering his will once again to God and thereby gaining redemption.[9]

Fallen man could not comprehend the mysteries of religion such as the Trinity nor could he fathom the unknown secrets of the material creation without the aid of revelation.

In works like *The religion of Satan or Antichrist delineated* Hutchinson made his opposition to religious nonconformity explicit. Despairing that "many in this present Age pretend to discover and know everything by their Reason, and the

Light of Nature, in contempt of Revelation,"[10] he identified modern freethinkers and dissenters with the apostate Jews – those who had corrupted the original unpointed Hebrew of the bible leading to false knowledge of religion and of nature. For example, contemporary Hebrew biblical texts masked the associative meanings between the Hebrew word for God 'elohim' and its root 'alah' meaning to swear or take an oath. These correspondences, apparent through a text purged of vowels, revealed the true triune nature of the deity and the holy covenant between God, the Son and the Holy-Spirit.[11] Jews and many anti-Trinitarians such as Newton denied this very important truth. By their rejection of the Trinity they challenged the Christian doctrine of the atonement.

While the Catholic Church preserved many of the chief articles of religion through tradition, modern Protestants followed the scriptural errors of the Jewish apostates, with the result that we "receive mostly Blasphemy from the Reformed, for the Benefit of Liberty of Conscience."[12] This was especially the case with anti-Trinitarians, deists and dissenting groups like the Quakers who rejected established religious authority of the Anglican establishment. Linking modern Jewry with radical religious and political nonconformity, Hutchinson declared that

> it is the political Interest of every Prince to suppress the Doctrine of the apostate Jews, because, notwithstanding late Offers to take Oaths of Allegiance, after their Manner, they never were, nor ever will be subject to any King, any longer than for their own Convenience, till they have an Opportunity to Rebel.[13]

Religious dissent was a forerunner of political anarchy. Those who promoted liberty of conscience like John Locke threatened the Anglican clergy's authority and its supporting role in the defence of monarchical power.

While Hutchinson did not play an active personal role in the political and religious controversies of his day, the political and religious rhetoric issuing from his writings indicate a passionate opposition to the radical Whiggery of freethinkers and republicans like Toland and Collins and a dislike of the Latitudinarian toleration for dissenting groups. Although from a relatively modest social background, Hutchinson strongly supported a hierarchical society of ranks and orders. The elitism of his patron the Duke of Somerset reflected Hutchinson's own beliefs in political and religious hierarchy, values that are evident in his writings on natural philosophy. Known as the proud Duke, Somerset had a high opinion of himself.

> He always delighted to live in Magnificence, Delicacy, and Splendor; constantly preserving that Respect and Dignity which was due to his Rank; and, like a Man of Birth and Fortune, ever moved in a Sphere above the Vulgar, thereby maintaining that just order and Regularity which proceeds from a Distinction of Persons, without which a State could not look comely, nor Government subsist.[14]

In Hutchinson's opinion Whigs, Latitudinarians, freethinkers and republicans as well as Newtonians threatened the order of society, the latter by suggesting that motion was inherent in matter, thus levelling the distinctions between God, man and nature. Such a blurring of distinctions could have devastating results for the traditional political and religious order. God, His political and spiritual representatives on earth and the meanest of the human race were reduced to the same level.

Hutchinson's opposition to Newton

Throughout Hutchinson's writings his opposition to Newton is evident. The primary source of Hutchinson's animus was his belief that Newton and his

disciples, by postulating the existence of attractive powers, had made motion inherent in matter. For Hutchinson, the active principles in Newton's universe did not impinge on and direct atoms that were passive by nature. By suggesting in the Latin *Optice* that matter was self-active, it appeared that Newton had concluded corporeal substance could move and act independently of divine agency, a particularly dangerous conclusion since it gave credence to the belief that matter could think and that the soul was material.[15] Furthermore, Newton's defence of absolute space and time and promotion of space as an attribute of God in the General Scholium and in the *Optice*, further blurred the distinction between God and His creation by implying that God was an extended part of nature. Like the other anti-Newtonians of this study, Hutchinson traced much of the heterodoxy of Newton's thought back to his followers Samuel Clarke and William Whiston and to freethinkers like John Toland. Thus Newton and his associates, by exalting reason and experiment above Revelation, had become apologists for radical Whiggery and freethinking.

Hutchinson thought many of the heretical errors of the Newtonians had their roots in ancient philosophers. While Newtonians at Oxford applauded the seeming continuity between Newton's natural philosophy and ancient knowledge as evidence of Sir Isaac's modesty, Hutchinson had a very different view of the matter. In his opinion, the learning of ancient Egypt and Chaldea was mired in absurdities. In works like *An essay toward a natural history of the bible* (1725) Hutchinson challenged the notion of an ancient wisdom. He was especially critical of the religion of ancient civilizations that he considered superstitious and pagan. Woodward, who rejected the notion of a prisca-sapientia and was a leading proponent of the moderns in the ancients-moderns controversy, may have

influenced Hutchinson.[16] Curiously, in his attacks on the scholarship of ancient Eygpt and Babylonia, Hutchinson emerges as an advocate of modern learning. While the ancients-moderns dispute clearly had a political dimension, the relationship between combatants in the dispute and politics and religion was as complex as political/religious allegiance and support for Newtonian natural philosophy.[17]

According to Hutchinson, the ancient Chaldeans, Israelites and Egyptians had first attributed hidden powers to matter. People in these societies worshipped nature – the stars, planets and the airs that were deemed responsible for natural phenomena. What was worse, they attributed the powers of these bodies to various animal images. For example, the God of air was styled Bel or Baal, and in each society different images were erected to praise Baal. Their greatest sin, however, was their attribution of powers to the airs; the airs thus acted independently of the Gods who created and commanded them. Modern idol worshippers like the Newtonians who set up nature for God were reviving the paganism of the ancient past. Hutchinson asked,

> If he believe his Senses, or Perceptions of the Actions in the material System, or his Imaginations, that there are other Powers in Matter, and goes no further; or if he believes them independent of God, or possest of some of his Attributes; is not he an Atheist, a Heathen?[18]

By ascribing occult forces to matter the Newtonians were reviving the ancient paganism of the past with dangerous consequences for the political and religious order.

Hutchinson clearly associated the belief in attractive powers with political and social levelling. If one abandoned revelation and naively argued from the appearances of things to the true constitution of reality, mysterious occult qualities were introduced into natural philosophy to explain phenomena such as

attractive powers. As Hutchinson declared in his *A treatise of power: essential and mechanical*, matter endowed with the principle of self-movement threatened to break

> down the Fences of Society, Government etc. For if it once be suggested, that the Powers are in Things which cannot know, reward, or punish, the Causes of Love and Fear cease, and those who are governed, either by Hopes and Fears, would be at Liberty to make any Inroads where human Laws do not punish with Death.[19]

Instead of attributing all causation to God who operated through secondary material agents, Newton had given power "to the meanest of their Subjects, inactive, unmechanized Matter, and made them do all the Work."[20] As North believed that Newton promoted a mob philosophy, so too did Hutchinson fear that Newtonian natural philosophy had levelled the distinctions between God and nature and King and subject leading to social anarchy.

The connection between Newton and several heterodox writers alarmed Hutchinson even more. Indeed, Hutchinson believed that Newton's statements on attractive powers, absolute space and God's role in the cosmos in the Latin *Optice* and in the General Scholium of the *Principia* (1713) linked him to freethinkers like Toland and Latitudinarian clerics such as Clarke and Whiston who had advanced anti-Trinitarian heresies. The period 1706-13, witnessing the emergence of a new more radical face of Newtonianism, was crucial for the formation of Hutchinson's negative views of Newton, as it was for the other anti-Newtonians of this thesis. In his *A treatise of power: essential and mechanical*, Hutchinson related that it was through Woodward as well as their [Clarke's and Toland's] own mouths that he had a full "Account of all Their Designs, divine or diabolical, and political or anarchical, the most openly from the author of *Motion essential to matter* and of *Pantheisticon*." Meeting with Hutchinson, Toland

made a "full Confession of all their Designs, and of all the Villanies and Forgeries they had committed to accomplish them."[21]

The close relationship between Clarke's Boyle Lectures *A demonstration of the being and attributes of God* and his editorship of the Latin *Optice* was not lost on Hutchinson. In 1705, the year of the publication of Clarke's Boyle lectures, Hutchinson claimed that Clarke had

> renounced the Christian Faith, and chose Jupiter, the Air, and the supposed Intelligence in it, the Object, which the latest Heathens worshipped for his God, and gives you the Definition of his Mind, Substance, and Extension from sundry Heathens, in his Demonstration of the Being and Attributes of God.[22]

Clarke had incorporated into his lectures Newton's notions of attractive powers and a vacuum to prove that God was one, eternal and infinitely extended. By editing the *Optice*, Clarke endeavoured to prove "that Jupiter's Substance was infinitely extended, and that he was Wise, Powerful, etc. and prove that Jupiter's Substance constituted infinite Space."[23] Clarke's influence was instrumental behind Newton's statements on space and time in the *Optice*, especially Newton's suggestion that space was the sensorium of God.

Clarke and other anti-Trinitarians like Whiston were behind Newton's statements on God in the Latin *Optice* and in the General Scholium. Speaking of Clarke's editorship of the *Optice*, Hutchinson declared

> Whether Side the Proposal came from, as the God was to support the Philosophy, and the Philosophy the God, I cannot determine. But it seems the God-maker had the stronger Party, and that our Author's interest was low, so they had him fast, and as they had published his Philosophy, they forced him to publish their Deus.[24]

Newton's theological statements in his published writings appeared to support the concept of God as an all-powerful deity who constituted duration and space. Clarke's publication of his Arian *Scripture doctrine of the Trinity* in 1712 and Newton's strong emphasis in the General Scholium a year later on God's

dominion (on the dominion of one) appeared interrelated. Indeed, it seems that Hutchinson, like North, viewed the General Scholium as an anti-Trinitarian tract supporting the heresies of Clarke and also of Whiston.[25]

But Clarke did not bear the sole brunt of Hutchinson's fury. Hutchinson was aware of Newton's own personal anti-Trinitarian views. He charged Newton with heterodoxy – Newton was a direct, if somewhat secret, proponent of heretical views. According to Hutchinson, Newton's lack of knowledge of the true Hebrew Scriptures had led him to reject the mystery of the Trinity. Newton's deficiencies as a biblical scholar did not allow him to

> form any Notion of the Trinity, [since] he could not read, so knew nothing of the Idea of their Existence in the Names, which has been, and is visible to all Mankind who can see. These poor Creatures supposed that the Doctrine of the Trinity depended only upon Notions, deducible from Speculations and their Way of reasoning, so Matters of no Certainty or Importance, did not know that there was clear Evidence in the Scriptures, much less that there was ocular Demonstration, when he drew up that cursed Definition of his Deus to make him one Person.[26]

Newton's emphasis on the dominion of one God in the General Scholium was part and parcel of both Newton's lack of Hebrew and his discoursing about God from the appearances of things. Instead, Hutchinson believed that by grounding natural philosophy upon scripture, true knowledge of nature could be known and religious mysteries like the holy Trinity confirmed. He sought to unveil a *Moses Principia*.

Hutchinson's cosmos

In many respects Hutchinson's cosmology may be described as a biblically based Cartesianism. His universe was a mechanical cosmos that functioned according to the contact action of invisible subtle parts that filled all space, the

airs or 'names' in their three modifications of fire, light and spirit. The mechanical action of the 'names' served as an important alternative to the attractive powers of the Newtonians to explain phenomena like gravity. While the three variations of the 'names' were symbolic for the three persons of the Trinity, Hutchinson was utterly opposed to efforts to use the ether to spiritualise nature as in the case of Berkeley. Albert Kuhn's claim that Hutchinsonianism advanced a form of mysticism must therefore be qualified, at least in the case of Hutchinson himself.[27] Hutchinson's God was a transcendent God that stood above nature. It is much better to characterise Hutchinson, as Chris Wilde has done, as a mechanist attempting to divorce spirit from matter, God from nature, in order to avoid the pitfalls of pantheism.[28] Natural and religious knowledge had to be grounded on revelation, and Hutchinson believed that he had developed the linguistic tools necessary to decipher biblical texts.

Central to Hutchinson's method was the recognition that the senses were limited and needed revelation to supplement them to provide knowledge of the subtle mechanical agents at work in the cosmos. While he subscribed to an empiricist theory of knowledge, he believed the limitations of our senses resulted in our having only partial knowledge of the hidden material processes at work in the universe. Arguing from the effects of nature to knowledge of the invisible world was a species of vanity. Instead humans had to turn to revelation for natural knowledge and from the bible make inferences about the physical world and vice-versa. As Hutchinson stated in *Moses principia* (part 2) he was in favour of bringing in "the Addition of Sense so far as that can go, and of comparing Revelation with the things seen, and of drawing Deductions for either or both."[29] Revelation provided vital knowledge of the mechanical processes at work at the

creation and during the flood, and Hutchinson's writings reflect a larger trend in seventeenth century thought to seek knowledge of history and nature from scripture.[30]

Hutchinson's desire to write a natural philosophical treatise that defended the truth of the Mosaic narrative was due to his apprehension about the declining respect for the scriptures as a source for knowledge, both natural and divine. The claims of earlier world-makers such as Burnet and Whiston that the Mosaic history of creation did not provide an exact true philosophical explanation of the creation and flood alarmed him, especially since such speculations frequently led to the conclusion that scriptural accounts of the creation and flood were a mere fable constructed to inoculate piety in the vulgar.[31] Such a view of scripture was similar to Hobbes and Spinoza, both of whom saw scripture as a convenient tool to teach obedience to political and religious authority rather than as a source of divine knowledge.[32] It was the ancient philosopher Philo, Hutchinson claimed in his *Glory and gravity essential and mechanical* (part I), who had introduced pointed Hebrew and allegory into biblical exegesis, leading to a loss of biblical philosophical knowledge and to the heresies of modern philosophers. Indeed, Hutchinson noted the convergence between Philo's beliefs on God, space and time and that of Clarke and Newton.[33]

The defence of the divine truth of the Judaic revelation was particularly important given the attacks on the authority of scripture by religious freethinkers. Radicals such as Charles Blount and John Toland advanced a *prisca theologia* – a form of pure natural religion that was communicated to Moses and eventually corrupted by later religious authorities. Such ideas found support in works like John Spenser's *De legibus Hebraeorum* (1685) that upheld the superiority of

Eygptian culture to that of the Jews, and argued for the pagan origins of the Mosaic Law. Along with the claim that Anglicanism was a corruption of pure primitive Christianity, challenges to the divine origins of the Hebraic scripture needed refutation, since these arguments could be used to attack the religious foundations of the clerical order. Indeed, John Woodward criticised Spenser's work asserting that to undermine the Jewish religion was a direct threat to the Christian establishment.[34] Throughout the eighteenth century challenges to the authority of Moses would provoke much religious controversy.[35] The divine Hebraic origins of the bible needed to be defended.

Hutchinson's solution was to go back to the original Hebrew text of the bible. By using pointed Hebrew (with vowels), present biblical texts did not reveal knowledge of the mechanical agents at work in the universe. Pointed Hebrew was a modern corruption of the originally pure Hebrew text based solely on consonants. Hutchinson and his later followers were biblical Hebraic alchemists. Geoffrey Cantor has shown how Hutchinson used two procedures to establish the associative meanings between various Hebrew words. One method enabled him to assign a range of meanings to words in scripture by consulting lexicons for additional meanings. The other approach allowed him to connect Hebrew words with the same unpointed consonants or the same roots, indicating associative meanings.[36] As David Katz has noted this, "in English, would be to argue that bad, bode, bid, bed, and bud were all possible meanings whenever the consonants bd appeared in a word."[37] Like an alchemist who had discovered the philosopher's stone, Hutchinson believed he had discovered the key to interpreting the Bible.

One can see the use of these methods in Hutchinson's analysis of the relationship between glory and gravity and space and matter. Hutchinson noted that the Hebrew word 'khoved' in some dictionaries meant to make heavy which he interpreted to mean to gravitate. The word in its unpointed form in some dictionaries also meant glory. Thus glory and gravity were conceptually related, and glory was representative of the light of Christ. Hutchinson believed that the similar consonant roots of the words 'sam' [he placed, put, disposed (space)] and 'shem' [a name (body)] refuted the Newtonian promotion of a vacuum by indicating a congruity between spatial extension and body.[38] Through similar analyses Hutchinson allegedly deduced a biblical cosmology that would serve as a viable alternative to the Newtonian orthodoxy.

In works like *Moses principia* (parts I and II), originally published in 1724 and 1727, Hutchinson provided, through his methods of biblical exegesis, an explanation for the creation and biblical flood via the operation of the mechanical agents or 'names' whose existence was revealed in scripture. For example, Hutchinson interpreted verse two, 'and the earth was without form, and void; and darkness was upon the face of the deep: and the spirit of God moved upon the face of the waters,' to argue that the earth was originally a mixture of dense matter and water without solid spherical form. After light was created from spirit, evidenced in verse three, 'and God said, let there be light: and there was light,' a second creation occurred separating the earth from the waters leading to the formation of the spherical earth. Once the mechanical agents were created, the evolution and operation of the cosmos continued via the mechanical interactions of light and spirit.

In contrast, the deluge resulted from God's miraculous suspension of the normal operation of these airs (fire, light and spirit). Hutchinson attacked both Woodward's and Whiston's explanations of the deluge through secondary causes. Regarding the latter he disparagingly remarked that Whiston's use of a comet to explain the flood was as sound as his anti-Trinitarian primitive Christianity.[39] By explaining the flood through the gravitational attraction of a comet passing nearby the earth, Whiston had mistakenly put gravity before revelation by explaining the flood through the use of fictitious attractive powers. Woodward, who had endeavoured to explain the resettlement of fossils in geological strata after the deluge via their specific gravities, was vulnerable to the same charge. While the normal course of nature was performed by the regular operations of fire, light and spirit, Hutchinson believed that God miraculously intervened in the case of the creation and flood to set His mechanical agents in motion and to suspend them. Like John Keill, Hutchinson worried that the theories of some world-makers threatened God's providence, but unlike Keill he believed that Newton was intimately linked to these dangerous theories.

The airs or 'names' set in motion at the creation were responsible for the orderly operation of the heavens. Their mechanical actions were examined in extended detail in the second part of *Moses principia* (1727). After the spirit supplied the fire or sun with matter to produce light, the universe operated according to orderly mechanical contact action. Light issued forth from the sun that condensed into larger grains or spirit that in turn returned to sun. Hutchinson described his cyclical cosmos as follows:

> First, in Grains, as it was made at first, and as it is successively reformed, and pressed toward the Part where the Action of Fire is. Second, the Part in Action Fire, the Machine or Manner in which the Darkness or Grains, pressed in, are divided and formed into small Parts or Atoms. Third, those small Grains, or

> Atoms of the Heavens, issued in Fluxes or Streams, which are called Light, till their Motion fail, and they be reformed to Darkness or Grains, and returned.[40]

According to Hutchinson, Moses had not concerned himself with the description of immaterial beings in the universe but only with the functioning of the 'names'.

With God's mechanical agents in the universe revealed, Hutchinson hoped that he could explain the causes of natural phenomena without recourse to the fictitious attractive powers of the Newtonians. This three-headed subtle agent influenced all bodies, the pressure of which gave to "each Atom that respective Degree of Tendency they call Gravity, towards the Part where the opposite Pressure is most obstructed by Fluids or Solids."[41] Hutchinson is often vague as to how these physical processes work. Often he represents light and spirit as contending parties in the universe. For example, light flowing one way and spirit the other in his cyclical cosmos is responsible for the earth's daily rotation: the "Spirit was ready, and as soon as there was Light, unavoidably, as I have hinted before, there would be Rotation."[42]

Hutchinson discussed in greater detail the role played by light and spirit in physical processes in his *Glory and gravity the mechanical or second part*, posthumously published a year after his death in 1737. In this work Hutchinson explained such phenomena as optics, fire, adhesion, projection, fluidity, elasticity, magnetism and gravity via the action of light and spirit. Corresponding to his belief that an agent may have several different significations for its many functions, Hutchinson noted that the agents have been given various words in the bible relating to their various uses. The bible

> call the Matter of The Names in Grains, which cannot pervade the Pores, ….. Spirit; that Matter in Atoms, or which can pervade Pores, when it gives Sensation to the Eyes, is called….. Light; when the same Matter expands, 'tis called ….. the Expander; when it compresses, and so gravitates, 'tis called ….. the Gravitor.[43]

Because spirit could not readily permeate the pores of bodies it was largely responsible for compression. Light's ability to penetrate into the interior of corporeal substance gave it the capacity to agitate bodies and put them into motion; it had an expansive function. By penetrating the pores of spirit, light could expand this compressing agent causing gravity.

While there are spiritual metaphors and echoes of Greene's expansive and contractive forces in Hutchinson's description of expansive and compressing agents, Hutchinson's cosmos was above all a mechanical universe where causation was attributed to material corpuscular agents. God was the Creator and first mover of matter and His subtle agents the instruments by which He acted in the universe. Through a close analysis of scripture and by our own observations of nature, the 'names' revealed the glory of God. Knowledge of God's role in the universe was not sought solely in our observations of nature; such an approach led to the conclusion that there were active powers in matter. Instead, the bible revealed God's agents that, although being representative of the three persons of the Trinity, were clearly separate from and subordinate to God.

The defence of political and religious hierarchy

Throughout Hutchinson's writings there are numerous places where he draws a strong analogy between God's role as governor of the 'names' and a Prince's absolute authority over his ministers and subjects. Such references are not mere metaphorical flourishes. Instead, they reveal Hutchinson's fear that Newton and his followers, by attributing powers and the principle of self-activity to matter, threatened to break down the distinctions between God and nature, thus

threatening the hierarchical distinctions between Kings and their subjects and Bishops and their parishioners. As with North, Hutchinson believed Newtonianism was a philosophy that supported political and religious sectarianism by breaking down the distinctions between governors and the governed.

In Hutchinson's universe God was the supreme commander in the cosmos who governed nature through His material instruments – fire, light and spirit. God's dominion over nature was absolute, but this was not the same sort of dominion that one finds in Newton's works. God was not immediately present in space nor was space the arena where God exercised His dominion, but rather God applied his influence through His material agents. As Hutchinson stated in *Moses principia* (part II), God was

> not only the Presider, but the Steerer of the Ship, and the Driver, as a Charioteer was of the Horses which drew the Chariot of War, or (etc) of the Matter and Powers which rule and move the Heavens and every thing in them, which he had constituted in that Office.[44]

Unlike a prince who had to live close to his ministers and subjects to communicate with them, God inhabited a region totally separate from persons and things and communicated to us via his mechanical agents. Only in the case of miracles would God directly intervene in the world, suspending the normal operation of the airs.

Hutchinson frequently compared light and spirit to subordinate rulers or viceroys who governed the universe under God's command. It was through the mediation of light and spirit that God ruled earthly beings. His ministers, the airs, exercised His will:

> the chief Lord gives every Thing, and what he has put into the Hands of these Rulers, his Subjects, by him constituted Governors, he gives by their Hands

> (which in Propriety of speaking, notwithstanding the learned Cavils, are his Hands) to the rest of his Subjects in this Empire.[45]

Symbolically the airs were the limbs by which God exercised his influence. In a similar fashion a minister, governor or judge implemented the wishes of a sovereign prince, and Hutchinson did not hesitate to draw an analogy between human and divine dominion:

> for what is done by a Vice-roy, Governor, General or Judge, has always been said to be done by the Prince who employs them; much more here, where the Prince [God] made the Matter and Things which act, and gave it the mechanical Powers of Action, and the Governor from nothing, who is to rule and divide, govern and judge.[46]

By putting sensory evidence before Revelation Newton and his followers had surrendered knowledge of God's dominion and His ministry just as republicans and freethinkers had rejected the authority of Princes, Bishops and their subordinates.

Through postulating attractive powers the Newtonians had made the mediation between God and His created world problematic. If matter could operate independently of divine agency what need was there for a hierarchical political and church structure to mediate between God and parishioners? The stakes were high, particularly given Newton's anti-Trinitarianism and the important function of the Trinity in Anglican thought. To question the divinity of Christ led to the refutation of the atonement and the Church's vital function in the saving of souls. As J. Champion explains:

> the Anglican position argued that Christ was the 'high-priest of the Church. Christ as the son of God was endowed with, and exercised, a sacerdotal power in his sacrifice, which was a complete satisfaction for man's sins. This Christology required that *sacerdos* was to be present in the temporal Church, identified in the priesthood..... The conception of Christ's sacrifice as a total propitiation of sins elevated the Church on earth to ministrators of this divinity: to undermine the sacrifice of Christ was to undercut the authority of the human priesthood.[47]

The loss of knowledge of the 'names' and the Trinity was therefore more than just an issue of philosophical doctrine. Of greater significance was the Anglican Church's role as a bearer of religious authority.

At the heart of Hutchinson's project then lay a defence of the Trinity, the knowledge of which could be known only through a proper interpretation of the bible. The Trinity was the foundation of Christianity – without it true religion could not subsist. Scripture revealed the triune unity through the operation of the 'names'. As Hutchinson stated in *Moses principia* (part II), "God is called Fire, the Father of light, Christ the Light and the Holy Ghost the Spirit; not only as these Things are used for Representations of them, but as they are his Agents; so their Substances, their Glory His, though created and material."[48] Here were the principles of nature revealed in the Mosaic narrative uncovered in all their glory.

Chris Wilde, in an illuminating article over twenty years ago, argued that Hutchinson's separation of spirit from matter was very much part of a strategy to defend a hierarchically structured society. In contrast, the conflation of spirit and matter by political radicals such as Toland and later in the eighteenth century by Joseph Priestley was indicative of their reforming agendas.[49] While the case of Robert Greene clearly illustrates how any definite straightforward relationship between natural philosophic views and political ideology is difficult to establish, it appears that for Hutchinson, North and Berkeley such distinctions were vital for the defence of political and religious hierarchy. Even Greene who reduced matter to force combined his unique views with a defence of a hierarchy of spiritual forces.

Newtonians, both Whig and Tory, believed that Newton had made such a distinction explicit, an interpretation that Hutchinson contested. One need only recall Newton's warning to Bentley of speaking of gravity "as essential and inherent to Matter. Pray do not ascribe that Notion to me."[50] Newton and his followers believed the Newtonian cosmos offered an excellent defence of God's providence against the materialist system of Descartes without descending into the pantheism of philosophers such as Spinoza. Hutchinson was acutely aware of alternative interpretations from his own. Referring to Newton's ether hypothesis published in the second English edition of the *Opticks* (1717) in *A treatise of power essential and mechanical*, he noted how one could construe Newton's ether as possessed of active powers or of offering a mechanical explanation for phenomena:

> here is a Choice left for his Friends: Those who have a Mind to make him an Atheist, may say he intended to put the supreme Power in the Aethers…..those who have a Mind to allow him to have been a Christian, may make him allow that the Aethers were the Agents which Jehovah Aleim appointed to be their Rulers in this System.[51]

Hutchinson clearly believed that the former group had appropriated Newton for their cause, and in his mind Newton, religious heterodoxy and political radicalism were synonymous.

As with Greene, Berkeley and North, Hutchinson believed that Newton and his supporters had to be challenged by offering a viable orthodox option. Like them he had his own individual solutions related to specific fears about the heterodox nature of Newtonian doctrine (as he understood it) and its pernicious consequences for the political and religious order. Only with Hutchinson though do we see an effort to derive a biblically based cosmology in defence of religion. Through his method of biblical interpretation the mechanical operation of the

'names' were revealed in all their glory. Scripture revealed the 'names' responsible for mechanical action. Mechanism was a refuge from nature worship of pagans and modern political and religious fanatics who placed themselves on the same level with Bishops, Kings and God. For Hutchinson, Newtonianism represented nothing less than the rise of modern paganism.

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[5] *Ibid*., v.

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[7] Joseph Levine, *Dr. Woodward's shield. History, science and satire in Augustan England* (Berkeley, 1977), 43.

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[10] Robert Spearman and Julius Bate (eds), *op. cit.* (ref 6), viii, 9.

[11] For important comments in this respect see David, B. Ruderman, *op. cit.* (ref 3), chap. 2.

[12] Robert Spearman and Julius Bate (eds), *op. cit.* (ref 6), viii, 67-8.

[13] *Ibid*., viii, 96.

[14] Anon, *Memoirs of the life, family, and character of Charles Seymour, Duke of Somerset* (London, 1749), 65.

[15] For controversies regarding thinking matter in the eighteenth century see John W. Yolton, *Thinking matter. Materialism in eighteenth century Britain* (Oxford, 1983). Both John Toland and Anthony Collins believed that the soul was material. See Stephan H. Daniel, *John Toland. His methods, manners and mind* (Kingston, 1984), chap 7 and James O'Higgins, *Anthony Collins. The man and his works* (The Hague, 1970), chap. 5.
[16] For Woodward's rejection of a prisca sapientia see Joseph Levine, *op. cit.* (ref 7), 75-9.
[17] Indeed, radicals like Toland promoted the notion of an ancient wisdom as readily as the High-Churchman John Keill, although for much different ends. For freethinking notions of a prisca-theologia see J.A.I Champion, *The pillars of priestcraft shaken. The Church of England and its enemies* (Cambridge, 1992), chap. 5.
[18] Robert Spearman and Julius Bate (eds), *op. cit.* (ref 6), i, 263.
[19] *Ibid.*, v, 42.
[20] *Ibid.*, v, 192.
[21] *Ibid.*, v, 253.
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[23] *Ibid.*, v, 253.
[24] *Ibid.*, v, 254.
[25] *Ibid.*, v, 260-61. For this reading of the General Scholium see Larry Stewart, "Seeing through the Scholium: religion and reading Newton in the eighteenth century," *History of science*, xxxiv (1996), 123-65 and Steven Snobelen "Isaac Newton, heretic: the strategies of a Nicodemite," *British journal for the history of science*, xxxii (1999), 381-419.
[26] Robert Spearman and Julius Bate (eds), *op. cit.* (ref 6), v, 155.
[27] See Albert J. Kuhn, *op. cit.* (ref 1) and "Nature spiritualized: aspects of anti-Newtonianism," *EHL*, xli (1974), 400-12.
[28] Chris Wilde, *op. cit.* (ref 1), "Hutchinsonianism....." and "Matter and spirit.....".
[29] Robert Spearman and Julius Bate (eds), *op. cit.* (ref 6), ii, pref iv. For a good discussion of Hutchinson's epistemology see Geoffrey N. Cantor, *op. cit.* (ref 2), esp. pp. 4-7.
[30] Peter Harrison, *The bible, Protestantism and the rise of natural science* (Cambridge, 1998), esp. chap. 4.
[31] *Ibid.*, 133. Whiston in his *A new theory of the earth* (1696) attempted to counter Burnet's claim that the Mosaic account was a mere fable by stating that Moses described Creation and the Flood as a man on earth observing it would, although Whiston like Burnet admitted that Scripture was not designed to provide an exact account of biblical events. See James E. Force, *William Whiston: honest Newtonian* (Cambridge, 1985), chap. 2.
[32] Gerard Reedy, *The bible and reason: Anglicans and scripture in late seventeenth-century England* (Philadelphia, 1985), chap. 2.
[33] Philo spiritualized and dematerialized the Stoic pneuma. God or spirit was thus present in the causal workings of his cosmos. For Philo's influence on Newton see Rudolf De Smet and Karin Verelst, "Newton's Scholium Generale: the Platonic and Stoic legacy – Philo, Justus Lipsius and the Cambridge Platonists," *History of science*, xxxix (2001), 1-30.
[34] Woodward attacked Spenser in an essay titled "Of the wisdom of the ancient Egyptians," which remained unpublished until its appearance in *Archaelogia* in 1777; however, it was in circulation in the early 1700s. See J.A.I. Champion, *The pillars of priestcraft shaken: the Church of England and its enemies, 1660-1730* (Cambridge, 1992), 156-58.
[35] This can be seen in the controversy sparked by William Warbuton's *The divine legation of Moses demonstrated* (1738-41) published shortly after Hutchinson's death. Warbuton had argued that the doctrine of a future state was not found in the writings of Moses for which he was criticized by Hutchinson's follower Julius Bate. See B.W.

Young, *Religion and enlightenment in eighteenth-century England. Theological debate from Locke to Burke* (Oxford, 1998), chap. 5.
[36] Geoffrey, N. Cantor, *op. cit* (ref 2), esp. pp. 12-17.
[37] David S. Katz, " 'Moses Principia': Hutchinsonianism and Newton's Critics," in James E. Force and Richard H. Popkin (eds), *The books of nature and scripture: recent essays on natural philosophy, theology and biblical criticism in the Netherlands of Spinoza's time and the British isles of Newton's time* (Dordrecht, 1994), 201-11, p. 203.
[38] Geoffrey N. Cantor, *op. cit.* (ref 2), pp. 14-15.
[39] Robert Spearman and Julius Bate (eds), *op. cit.* (ref 6) i, 73.
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[41] *Ibid*., ii, 91.
[42] *Ibid*., ii, 252-3.
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[50] Newton to Bentley, Jan 17, 1693, in I.B. Cohen (ed.), *Isaac Newton's paper and letters on natural philosophy and related documents* (Cambridge, 1958), 298.
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Conclusion

This dissertation has provided an analysis of the responses of Jacobite, Tory, High-Church and Scottish Episcopalian natural philosophers to Newton and his natural philosophy from the publication of his *Principia*. While some opposed Newton others drew selectively from his writings to challenge their political and religious opponents. I have argued that scholars must move beyond the Whig Low-Church Newtonian and Tory High-Church anti-Newtonian (or anti-science) antithesis established by Margaret Jacob, while at the same time recognising the important role of political and religious allegiance in past scholarly appraisals of Newton. Instead of a straightforward causal link between politics, religion and support for Newtonian natural philosophy, one must explore the different readings and uses of Newton in various political, religious and institutional contexts. By doing so a much more complex picture emerges of Newton's relationship to English and Scottish political and religious conservatives than has previously been noticed by historians of science. As an alternative to a single definition of Newtonianism, this thesis has demonstrated the many different meanings that Newtonianism had for both Newton's Tory/ Jacobite supporters and opponents, a diversity that largely accounts for the multi-faceted reactions to Newton and his natural philosophy, even within the pro-Newtonian and anti-Newtonian camps. By studying Newton's disciples and enemies these many faces become transparent.

For the Jacobite Episcopalians David Gregory, Archibald Pitcairne and their followers, Newtonianism was the mathematical natural philosophy of the

Principia combined with a cautious experimentalism. Gregory and Pitcairne praised Newton for his use of mathematics in natural philosophy and his unwillingness to make rash speculations about the causes of gravity. Mathematical certainties and the orderly operation of the laws of nature were contrasted with the uncertain hypotheses of Cartesian natural philosophers, medical theorists and empirics that bred disorder and factionalism in philosophy and society. Newton's *Principia* was viewed as useful to battle philosophical, political and religious enthusiasm. At Oxford Gregory's and Pitcairne's disciples agreed with this assessment, but also viewed Newton's unwillingness to offer speculative explanations for gravity as evidence for his modesty, a belief that found support in Newton's great reverence for the ancients. In addition, Newton's system of the world, especially his postulation of active principles in the universe, was seen by Oxford Newtonians to provide strong support for the existence of God and His providence. Despite Newton's private anti-Trinitarianism and world-making speculations, he emerged at the university, or more specifically at Christ Church, as a pious modest natural philosopher whose work did not challenge the authority of the ancients or the established church.

Chapters four to seven illustrate how a very different image of Newton surfaced among some Tory High-Church natural philosophers. Despite their promotion of different natural systems Robert Greene, George Berkeley, Roger North and John Hutchinson associated Newton in various ways to the radical deism of early eighteenth century English freethinkers and to the heterodox thought of Spinoza, Epicurus, Descartes and Locke. While Newton's reluctance to draw definitive conclusions about the cause of gravity and the structure of matter could be interpreted as evidence for his modesty, Newton's speculations

about attractive powers, atoms, and absolute space and time in the queries to the *Opticks* and in the General Scholium, could be interpreted as providing support for materialist cosmologies that banished God from the universe or that led to pantheism. Opponents of Newton, like Greene and Berkeley, criticised him for being a speculative corpuscular materialist. By abandoning strict empiricism and speculating about imperceptible entities in the Queries to the *Opticks*, Newton seemed to be continuing the tradition of ancient and modern atomists and corpuscular philosophers who explained phenomena solely in terms of matter in motion. Paradoxically, Newton could be criticised as a vain experimentalist. By basing his natural philosophy on experimental observations instead of on rational first principles or on scripture, North and Hutchinson believed Newton had falsely attributed attractive forces to matter, blurring the distinction between spirit and matter and leading to full blown pantheism. Berkeley, who in *Siris* had attempted to appropriate ethereal hypotheses to defend religion, also expressed this fear. Along with the theological problems associated with Newton's theory of absolute space and time and the involvement of Clarke and Whiston in anti-Trinitarian controversies, Newton could be linked to heterodox thought that challenged the legitimacy of the Anglican establishment.

These appraisals and portrayals of Newton occurred in significantly different contexts. In Scotland, Gregory and Pitcairne saw natural philosophy, especially Newton's, as a refuge from militant Presbyterian fanaticism that threatened political, religious and social hierarchy. Reason and mathematics countered the perceived backwardness and anti-intellectualism of many Presbyterians. Gregory and Pitcairne considered mathematics, especially geometry, useful in the defence of hierarchy and a patrician hegemony. Within the context of the Scottish

medical disputes of the 1690s, Pitcairne and his younger medical followers contrasted Newtonian mathematical medicine, the physic of elite philosophers, with that of plebeian medical Whig empirics such as Andrew Brown whose empirical approach was combined with vain theories based on Cartesian physiology. When Gregory and other Scots like Keill and Arbuthnot settled in Oxford, they, along with medical men such as Freind, sought to promote Newton as a champion of Anglicanism. Given the heightened alarm at High-Church Oxford with the use of reason and natural philosophy to undermine religious mysteries and orthodox doctrine, it is not surprising that Oxford Newtonians emphasised Newton's modesty and piety, confirmed by his great respect for ancient learning and his resolution of gravity into the power and providence of God. Conscious of the theological disputes sparked by the Convocation controversy and the spread of heterodox deistical literature, Oxford Newtonians at Christ Church portrayed Newtonian natural philosophy as a viable philosophical option for the devout, a message that at least partly explains the lack of direct attacks on Newton in the early eighteenth century by Tory High-Church satirists of science.

The causes of anti-Newtonianism are more inchoate, since Greene, Berkeley, North and Hutchinson did not form a scholarly circle or a correspondence network. Yet there are common roots for their disaffection with Newton. The separation of the anti-Newtonians of this study from the English scientific establishment, centred at the Royal Society of London and its president Isaac Newton, is itself suggestive of an origin for their opposition. Greene, Berkeley, North and Hutchinson largely stood outside of prominent scientific institutions; they never were close to Newton or partook of an active role in the Royal Society.

They sought prestige by challenging Newton rather than seeking influence through his patronage. More importantly, they viewed Newton largely through the lens of the *Opticks*, especially the *Optice* of 1706 with its speculations on matter theory, attractive powers and empty space. There is thus an important chronological element to their opposition. Newton's speculative queries and metaphysics seemed to support the notion that motion was inherent in matter and that God – hovering in absolute space – was a material being, while at the same time promoting the corpuscular philosophy of heterodox philosophers. Given the use of Newtonian attraction by radicals like Toland, the congruence between Clarke's views on space and time and Newton's, the influence of Clarke on the publication of the *Optice* and the subsequent General Scholium and the involvement of Clarke and Whiston in Trinitarian controversies, it was possible to connect Newton to Whigs, republicans, Latitudinarians and deists, a connection that became more acute with the establishment of Whig Low-Church hegemony after 1715 and the growing influence of Newton within the British scientific establishment.

By analysing the contexts and manner in which Tory/ Jacobite Newtonians and anti-Newtonians expressed praise or condemnation of Newton one can gain a better understanding of the nature of support and opposition to Newton among Tories. Supporters were introduced and became firm converts to Newtonian natural philosophy before the publication of the *Opticks* in 1704 and the entanglement of Newton's Whig followers in the thickets of theological controversy. They actively sought political, ecclesiastical and scientific patronage, took an active part in the Royal Society and the Royal Colleges of Physicians of London and Edinburgh and held prominent university chairs of astronomy and

natural philosophy. More importantly, they formed a cohesive group of scholars with shared political and religious cultural ties and natural philosophical commitments. Operating in specific locations and communicating through correspondence networks, they achieved a considerable degree of consensus about what was good and positive about Newton and his natural philosophy. This provided cohesiveness to their appraisals of Newton that was absent in the critiques of anti-Newtonians; it added to the strength of their attempts to appropriate Newton for the Jacobite Episcopalian and Tory High-Church cause in Scotland and England.

In contrast, anti-Newtonians did not form such a cohesive group; their works were written in isolation from each other. Their criticisms varied with the alternative natural philosophies they advanced. While Greene and Berkeley (pre-*Siris*) attacked Newton's atomist and corpuscularian theories, North, Hutchinson and Berkeley's *Siris* used corpuscular mechanisms to counter Newtonian attractive powers. Greene and Berkeley sought to spiritualise nature by emphasising God's eminence, but North and Hutchinson promoted God's transcendence over His material creation in order to avoid the pitfalls of pantheism. Greene's philosophy of expansive and contractive forces, Berkeley's idealism, North's Cartesianism and Hutchinson's scriptural natural philosophy each represented very distinct systems. Indeed, this diversity of response is a key characteristic of anti-Newtonianism. What led Greene, Berkeley, North and Hutchinson to challenge Newton was their eccentricity, independence and belief that they alone had the ability to offer a more viable orthodox natural philosophical alternative. This explains the heterogeneous nature of the anti-

Newtonian opposition but also their inability to mount an effective campaign against Newton and his followers.

This fractured character of anti-Newtonianism along with the ability, within certain contexts, to appropriate Newton for the Tory High-Church cause, explains the positive appraisals of Newton by many Tories after his death. Indeed, the examples of the Tory mystical writers William Law, John Byrom and John Wesley indicate that Newtonian natural philosophy could be used to support religious mysticism in the 1730s and 40s. Law himself believed that Newton's principle of attraction was derived from the mystic Jacob Boehme, one of his own spiritual mentors. It was possible that Law was led to this conviction by George Cheyne, now a successful physician at Bath and a member of Law's mystic circle in the 1730s.[1] Steeped in the mysticism of the Scottish North-east and the continental mystics Antoinette Bourignon and Jean Guyon, Cheyne's *English malady* (1733) attempted to reconcile Newton's ethereal hypothesis with a spiritual neo-Platonic universe of intermediates, occupying a region between divine spirit and gross matter.[2] Unlike Greene and Berkeley, Law and Cheyne sought to use Newton to promote spiritualism rather than challenge him.

The same strategy can be detected in the works of Hutchinson's followers later in the eighteenth century. While Hutchinson vigorously attacked Newton in his writings, his later followers argued for a compromise between Hutchinson's biblical natural philosophy and the Newtonian ether. Hutchinson's disciples such as Duncan Forbes, George Horne and William Jones did not deny the validity of Newtonian laws of matter and motion; instead they sought explanations for motion through a rapprochement of Hutchinsonian mechanism and the Newtonian ether. Newtonian natural philosophy was not false; rather Newton

lacked complete knowledge of the material agents in the universe, knowledge that Hutchinson's biblical interpretation was meant to supply.[3] The association of Hutchinsonianism with anti-Newtonianism therefore is not clear-cut. Despite Hutchinson's own fervent attacks on Newton, his followers appear to have lacked the desire for a full frontal assault against him. They too attempted to use Newton to defend orthodox Anglicanism.

Although there was always the potential to associate Newton with radical Whiggery and religious freethinking, it appears that such direct linkages were rare and sporadic in the early eighteenth century, even more so were attempts to offer alternative natural philosophies. It was much easier to attack Clarke and Whiston and their sinister influence on the great man than Newton himself. Newtonianism was a many-headed beast that could be used to defend or undermine the political and religious establishment in England. In the early eighteenth century Newton was too highly respected for most scholars to attack; one therefore sees many attempts by Tories High-Churchmen to co-opt Newton instead of confuting him. By focussing on multiple readings of Newton instead of assuming a one-dimensional relationship between politics, religion and natural philosophy, one can acquire a more thorough knowledge of the Tory High-Church response to Newton. It is hoped that this thesis will make a contribution to our historical understanding of the triumph of Newtonian natural philosophy in early eighteenth century Britain along with the relationship of Tories and High-Churchmen to the English Enlightenment.

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[1] A.J. Kuhn, "Nature spiritualised: aspects of anti-Newtonianism," *ELH*, xli (1974), 400-12. Kuhn labels Law as anti-Newtonian despite Law's belief of Newton's dependence on Boehme.

[2] Anita Guerrini, *Obesity and depression in the Enlightenment. The life and times of George Cheyne* (Norman, 2000), chap. 6.

[3] For this rapprochement see B.W. Young, *Religion and enlightenment in eighteenth-century England. Theological debate from Lock to Burke* (Oxford, 1998), chap. 4.

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