Isaac Newton: His Science and Religion

Stephen D. Snobelen

NEWTON IN HISTORY AND HISTORIOGRAPHY

The creation of a myth

"In the eighteenth century and since, Newton came to be thought of as the first and greatest of the modern age of scientists, a rationalist, one who taught us to think on the lines of cold and untinctured reason". Thus wrote the British economist John Maynard Keynes in the early 1940s in a paper he had prepared for the tercentenary of Newton's birth. The man that Baron Keynes describes is the Newton of contemporary popular culture. This is the Newton of scientific rationalism, the modern secular age and the clockwork universe. The roots of this conception can be traced back to Enlightenment apologists who championed Newton's empiricism and the mechanistic features of the *Principia* even while they downplayed or neglected Newton's theological agenda for his natural philosophy. In the writings of Voltaire, in D'Alembert's Preliminary Discourse to the *Encyclopédie* (1751) and in numerous other Enlightenment hagiographies, Newton became the patron saint of the Age of Reason.

During the eighteenth century there was a greater awareness of Newton's natural theology in his native Britain than in France, and several of Newton's earliest British supporters drew attention to the brief excursions into natural theology found in the Queries to the *Opticks* and the General Scholium to the *Principia*. Nevertheless, little was known of Newton's personal religious faith and by the twentieth century even the natural theology had receded from view in the public mind. Such was the success of the Enlightenment marketing campaign that the British Romantic poet William Blake came to see Newton as epitomizing cold, soulless reason. In Blake's famous 1795 painting "Newton", the person on display is gazing down on a geometrical figure on the earth, not up to the dwelling place of God in heaven. If Blake had known Newton's private thought rather than the public, constructed image of a mechanist, he likely would have found in him someone closer to a kindred spirit than the object of animus and scorn.

The lingering awareness of Newton's theological interests caused concern for some apostles of secular science. But there were ways of dealing with the theology. Two French scientists, Pierre-Simon de la Place and Jean-Baptiste Biot, were instrumental in the construction of a legend that Newton suffered a breakdown after a putative 1693 fire that incinerated stacks of his manuscripts. It was only after this breakdown and the concomitant enervation of his intellect, so the legend goes, that Newton turned to theology. Such a sequence of events was amenable to their positivist sensibilities, since it implied that Newton's greatest achievement (the *Principia*) was not tainted by putatively weak and pointless theological speculation.

Although this story has been decisively disproved, one can still find in current historiography the suggestion that Newton's later addition of the General Scholium to the *Principia* is evidence that he superadded theology to a treatise that had nothing to do with it. One also still encounters the argument that despite Newton's keen interest in religion and natural theology, he somehow managed

to keep his physics separate from his faith. On this view, Newton comes off looking like a proto-positivist and a model for modern secular science. Recent developments in Newton scholarship make both of these views untenable.

The unravelling of the myth

When Newton died on 20 March 1727 he left behind a treasure trove of manuscript material. Few even today know that Newton's unpublished writings dwarf what was released to the public in his lifetime. Newton's executors found something like one million words on alchemy and as much as three million words on theology, church history and biblical prophecy. It is the invisibility of these papers—documents that detail a very different Newton than the one of public conception—that allowed the creation of the myth of Newton as a herald of the Age of Reason. Newton himself is largely to blame for this, as he kept his manuscripts from all but a few of his most trusted friends. Due in part to the heretical nature of some of the theological manuscripts, Newton's collateral descendants kept a tight lid on the chest than contained them, only occasionally allowing access to scholars. All of this changed in 1936. In that year the earl of Portsmouth (in the possession of whose family the manuscripts had remained since 1740) had the alchemical and theological manuscripts auctioned at Sotheby's in London.

Although the subsequent break-up and dispersion of the papers around the globe was a temporary disaster for the study of Newton's thought, by the 1970s the majority of the manuscripts had found their way into libraries and other institutions. The two largest collections of alchemical and theological papers were those purchased by John Maynard Keynes and the Jewish orientalist Abraham Shalom Ezekiel Yahuda. Keynes was stunned by what he saw. After writing the sentence quoted at the beginning of this article about Newton's reputation as "the first and greatest of the modern age of scientists", Keynes asserted:

> I do not see him in this light. I do not think that any one who has pored over the contents of that box which he packed up when he finally left Cambridge in 1696 and which, though partly dispersed, have come down to us, can see him like that. Newton was not the first of the age of reason. He was the last of the magicians, the last of the Babylonians and Sumerians.

Keynes left his collection to King's College, Cambridge in the 1940s. Yahuda's larger collection arrived in Israel in the late 1960s and now forms part of the holdings of the Jewish National and University Library in Jerusalem—a library that also owns some of the papers of Albert Einstein. In 1991 the majority of Newton's manuscripts (natural philosophical, administrative, alchemical and theological) was released on microfilm. It was at this time that the study of the "other" Newton began in earnest.

The next chapter of this story came in 1998 with the foundation of the Newton Project. Not only is the Newton Project bringing about unprecedented access to Newton's private manuscripts through online publication, but the rendition of Newton's writings into an electronic format has opened up the application of new types of textual analysis. The manuscripts paint a picture of an active alchemist and passionate lay theologian who spent the better part of the decade preceding his composition of the *Principia* leaning over his alchemical crucible and leafing though his Bible. What follows is a synopsis of the revelations these manuscripts contain.

NEWTON AND THE ANCIENT WISDOM

The birth of a searching mind

Newton's birth at Woolsthorpe Manor in Lincolnshire on Christmas Day 1642 seemed inauspicious enough. A small child born into the world after the death of his father, the women attending his mother were convinced that he would not survive the day. That he did survive is a matter of history. But the details of his early years shed light on the personality who would go on to create a new physics that has survived into the space age. The English Civil Wars of the 1640s formed a constant backdrop to his earliest years, and the biblical piety of Puritanism associated with his period helped shape the young Isaac's religion and morality. Newton's sense of solitude as a fatherless child without full-blooded siblings would have been reinforced as he suffered through the temporary loss of his mother from the ages of three to eleven when she married and lived with a neighbouring clergyman in his sixties (a marriage Newton apparently resented). Two years after her return in 1653, Isaac was shipped seven miles north to the King's School in Grantham, where he lodged with an apothecary. It was at the King's School that Newton's promise as a scholar was first recognised.

A new world opened up before Newton when he arrived at the University of Cambridge in 1661. Although the training at Cambridge was still dominated by a Medieval curriculum that focussed on classical authors such as Plato and Aristotle, Newton was soon attracted to the figures of the new mechanical philosophy, and chief among these was René Descartes. A notebook Newton began as an undergraduate reveals the direction in which his thought was moving. Two pages of notes on Descartes are followed by a series of notes on a wide range of topics that include attraction, comets, colours, cosmology, gravity, light, matter, optics, time, vortices and the vacuum.

Two other features of this notebook signal interests that would become life-long passions. First, the notes show that Newton began to take an interest in ancient alternatives to Aristotelian philosophy, such as Epicureanism (although Newton always rejected atheistic readings of this school). Second, several examples from the notebook demonstrate that Newton was already integrating theological considerations into his study of natural philosophy. Partly due to these two interests, Newton's confidence in modern Cartesian physics gradually began to erode. An important dynamic here was the troubling sense that Descartes' mechanical philosophy left little or no room for God. The Cambridge Platonist Henry More and the Cambridge mathematician Isaac Barrow were also raising similar concerns.

Meanwhile, Newton became a major Fellow of Trinity College in 1668 and was appointed Lucasian Professor of Mathematics at Cambridge the following year at the age of twenty-six. Shortly before this, he had taken up alchemical experimentation in earnest. Shortly after this, Newton came to the attention of the world of natural philosophy through his invention of the first working reflecting telescope and his revolutionary paper on colours, published in 1672 in the *Philosophical Transactions of the Royal Society*. This paper demonstrated inductively through the experimental use of common glass prisms the counter-intuitive conclusion that white light is not homogeneous, as previously thought, but heterogeneous, consisting of all the colours of the rainbow. Just shy of his thirtieth birthday, Newton's place in the history of science was secure.

The *Principia mathematica*

It was not until the early 1680s that Newton completely broke with Cartesian physics. Descartes had

hypothesized that the planets were carried around the sun in vortices of subtle aether particles much like corks in a whirlpool. This provided an intuitive explanation for the orbits of planets, travelling as they did in the same direction and on the same plane. But when Newton concluded that comets, too, orbited the sun in closed orbits (albeit in extremely elongated ellipses), the vortex was unable to account for their motion, travelling as they did in east-west, west-east, north-south and south-east directions. In August 1684 he received a visit from Edmond Halley, who asked him if he could provide a mathematical demonstration for the elliptical orbit of a planet caused by the attraction of the sun, which decreases in a proportion inverse to the square of the distance between them. This elicited from Newton his nine-page "De motu" ("On motion"). But this was only the beginning. For nearly two years he worked at a feverish pitch until he had solved to his own satisfaction the problems of terrestrial and celestial mechanics. The final product of these years came in 1687 with the publication of the *Philosophiae naturalis principia mathematica* (*Mathematical principles of natural philosophy*), seen by historians of science as the single greatest work of the Scientific Revolution, if not the entire history of science.

The new cometography, the Inverse-Square Law, and much else besides, found its way into the three books of the *Principia*. Shunning the causes and metaphysics of the Medieval Scholastic natural philosophers, Newton's work is descriptive in nature and deploys a majestic mathematical physics to describe his three laws of motion and universal gravitation. Over the course of the three editions of this book Newton also outlined four "rules of reasoning" that centred around the parsimony principle, the universality of natural phenomena and the inductive method. The *Principia* also represents the culmination of a movement that had begun almost a century and a half earlier with the heliocentric theory of Nicholas Copernicus's *De revolutionibus orbium coelestium* (*On the revolutions of the heavenly spheres*, 1543), namely, the unification of terrestrial and celestial physics. The grandest achievement of the *Principia* is its mathematical description of the motions of the heavenly bodies found in Book III. Such is the effectiveness of the physics of the *Principia* that it continues to serve science well in the space age.

Although at first glance the first edition of the *Principia* appears to be secular work, there was more there that met the eye. In addition to a reference to the interpretation of Scripture in the Scholium on the Definitions near the beginning, in Book III Newton observes that the smallest and densest planets are nearest to the sun and concludes that "God placed the planets at different distances from the sun so that each one might, according to the degree of its density, enjoy a greater or smaller amount of heat from the sun".

Manuscript parallels written during the composition of the *Principia* also reveal that the distinctions he sets out in his Scholium on the Definitions between absolute and relative time, space, place and motion were related to his belief that astronomical phenomena in the Bible were to be interpreted in relative senses amenable to the common people. What is more, the four rules of reasoning bear a remarkable similarity to some of the rules of prophetic interpretation he had set down over a decade earlier at the beginning of a long treatise on the Apocalypse. All of this confirms what he wrote to the young Cambridge clergyman Richard Bentley in 1692: "When I wrote my treatise about our System I had an eye upon such Principles as might work with considering men for the belief of a Deity and nothing can rejoice me more than to find it useful for that purpose".

While little in this great work would have suggested that Newton believed he was recovering lost ancient wisdom about nature rather than discovering things unknown to humanity until his time,

he did contemplate publishing a different version of Book III that would have made this clear. In the introduction to his "System of the World", Newton wrote that "in the earliest ages of philosophy" it was believed that the earth was a planet, that it "described an annual course about the sun ... and that the sun, as the common fire which served to warm the whole, was fixed in the centre of the universe". This, Newton contended, was taught by Aristarchus of Samos, the sect of the Pythagoreans, Anaximander and other ancient philosophers.

The heliocentric solar system was commemorated in the architecture of the ancient temples, which were situated around a central fire to symbolize the sun. The notion of crystalline spheres to explain the circular motion of the planets was a later corruption, Newton related, "when the ancient philosophy began to decline, and to give place to the new prevailing fictions of the Greeks". The construct of solid orbs hindered the study of astronomy because it artificially confined comets to the sublunary world. Newton's "System of the World" also includes a natural theological argument based on the relative densities of the planets. None of this was seen by the public until this alternate version of Book III was published in 1728.

The *prisca sapientia* and the Classical Scholia

The introduction to his "System of the World" confirms that Newton was a proponent of the Renaissance commonplace of the *prisca sapientia* (ancient wisdom), the belief that the ancients had once possessed pure forms of philosophical and theological truths that were subsequently lost or grossly corrupted. Although he suppressed his "System of the World", in the early 1690s Newton toyed with the idea of including even bolder statements in a second edition of the *Principia* he then began to envision. The Scottish mathematician David Gregory learned of these intentions during a May 1694 visit with Newton at Cambridge. Gregory recorded that Newton "will spread himself in exhibiting the agreement of [his] philosophy with that of the Ancients and principally that of Thales. The philosophy of Epicurus and Lucretius is true and old, but was wrongly interpreted by the ancients as atheism".

The surviving drafts of this material, now referred to as the "Classical Scholia", confirm Gregory's testimony. In this material Newton articulates the views that the ancients (including the pre-Socratic Ionian Greeks and the Pythagoreans) had both possessed a heliocentric view of the solar system and a knowledge of universal gravitation. Anaxagoras, Newton argues, knew about the heaviness of the moon (many other later Greek philosophers holding that it was light and aetherial) and the gravitational attractive powers of the moon and the sun. These truths, however, were hidden by Anaxagoras in the figures of a lion falling from the moon and a stone falling from the sun, with Newton concluding that "the mystic philosophers usually hid their tenets behind such figments and mystical language".

Elsewhere in the Classical Scholia Newton suggests that the ancients cloaked their knowledge of the Inverse-Square Law of gravitation behind the figure of Apollo and his seven-stringed lyre. "Through this symbol", Newton explains, "they indicated that the sun acts on the planets with its force in the same harmonic ratio to the different distances as that of the tensile force to strings of different length, i.e., in a duplicate inverse ratio to the distances". In all this, Newton insinuates that the ancient philosophers operated in a manner like the sect of the Pythagoreans and the early modern alchemists, revealing their secrets only to the initiates and presenting them in public only through coded language. This strategy directly clashes with the ideals of modern scientists. But

Newton was a natural philosopher, not a scientist.

NEWTON AND THE ORIGINAL RELIGION

Heresy and the recovery of Primitive Christianity

One of the requirements of Newton's fellowship at Trinity College was that he be ordained by 1675. The impending ordination deadline is likely one of the reasons why, in the early 1670s, he began to study theology and church history in earnest. One of the results of this intensive study was his conclusion that the central doctrine of orthodoxy Christian, the Trinity, was a corruption based on a misreading of the Bible and the addition of hypothetical ideas deriving from Greek metaphysics. It is not without irony that his denial of the Triunity of God came while domiciled in the cloisters of the College of the Holy and Undivided Trinity. Such was Newton's character that he could not in good faith become an Anglican clergyman, since it would mean accepting all Thirty-Nine Articles of the Church of England. Although he had accepted them when he became a major Fellow of Trinity in 1668, after the early 1670s he could never do this again. In the eyes of the Anglican Church, he had become a heretic.

A heretic, yes, but not a public one. Newton opted to keep his heresy secret, revealing it only to his closest associates, much like a Pythagorean revealing his intimate secrets only to the initiate. Fortunately for Newton, without revealing what likely were his true intentions, he was able to obtain a special royal dispensation that exempted the Lucasian Professor from taking holy orders. If this exemption not been granted, Newton had been prepared to resign his fellowship and, it seems, leave Cambridge entirely. Had he not become a heretic and had he been ordained as was required, it is possible that he would have been given preferment in the Church and moved on to some parish to serve as a priest. Thus it may well be because of Newton's heresy, and a royal dispensation unwittingly granted to a heretic, that Newton went on to write a book that changed physics forever.

Whatever the case, unknown to the wider world, Newton was to remain a lay theologian. The most important result of his study of the Bible and church history was his conclusion that the doctrine of the Trinity was a corrupt dogma that did not accurately reflect the biblical teaching on the oneness of God. In a 1670s list of twelve statements distinguishing Christ from God, Newton wrote: "Whenever it is said in the scriptures that there is but one God, it is meant of the Father". Further clarification is provided by another statement from the same list: "It is a proper epithet of the father to be called almighty. For by God almighty we always understand the Father". For Newton, only the Father is the one true God.

Newton believed that Jesus Christ preexisted his human birth and was miraculously born through the agency of the Holy Spirit, making him the Son of God in a literal sense. But he concluded that the Bible does not speak of Christ as consubstantial with the Father in the Trinitarian sense. They are united in will, but not substance. The introduction of the doctrine of three consubstantial, coeternal persons Newton attributed to the corrupting influence of Athanasius and his cohort. While in the annals of orthodoxy Athanasius is a champion of truth who merits his title as a saint, for Newton he was the author of error and an immoral scoundrel. Newton also came to believe that the immortality of the soul is an unbiblical doctrine, concluding instead that the afterlife is attained only through the bodily resurrection.

Many elements of Newton's theology resemble views held by the antitrinitarian Socinians on the continent and the nascent Unitarians in England. While we now know that he consulted the works of his fellow antitrinitarians, much of what Newton believed came from his own personal encounter with the biblical text. Newton's biblicism should not be underestimated. The direction of his theological thought was also determined in large part by his Christian primitivism, the belief that the earliest forms of Christianity were the purest and thus must be recovered at all costs. It would be a mistake to conclude that Newton's antitrinitarianism reflects an incipient rationalism rather than a strong biblical faith and a powerful primitivist drive, or that his denial of the Trinity renders him a proto-deist when in fact his thought was powerfully anti-deistic in tone and intent. Newton was no more a deist than advocates of Judaism, who also believe in a unipersonal God who acts in the world. Nor would a deist see, as Newton surely did, a role for Christ as a redeeming saviour and a coming judge.

Prophecy and millenarian eschatology

Newton's prophetic thought also demonstrates his distance from deism. True deists looked askance at biblical prophecy. Not only did Newton affirm a generally literal view of the fulfilment of the prophecies of the Bible, but he found in the fulfilment of prophecy one of the best arguments for the existence of God and, in opposition to deism, the activity of Providence in history. In his premillenarian eschatology and historicist approach to the interpretation of prophecy, Newton followed the lead (albeit not slavishly) of Joseph Mede (1586-1638) of Christ's College, Cambridge. Newton wrote several long treatises on the interpretation of the book of Revelation (the Apocalypse), including a 550-page text dating from the 1670s. Another treatise dates from the period of the composition of the *Principia*, while yet another was written in the first decade of the eighteenth century.

Newton believed that prophecies in the Old and New Testaments foretold the return of the Jews to Israel, the rebuilding of the Jewish Temple in Jerusalem, the battle of Armageddon, the return of Christ to the earth and the establishment of a global kingdom of peace for one thousand years. He also believed that the 1260 days of Daniel and Revelation pointed to 1260 years of the corruption of the Church. Holding that this likely began when the papacy gained temporal power, he combed the annals of history for a plausible commencement date for this prophetic time period. He considered 607 and 609 A.D. and, later in life, 800 A.D., with the latter date suggesting that the apocalyptic events foretold in the Bible would not begin to come to pass until around the year 2060, long after his death.

At the center of Newton's prophetic scheme is his animus directed against the Roman Catholic Church, which he charged with corrupting the primitive simplicity of Christianity through ungodly alignments with temporal authorities, the corruption of the text of the Bible and unscriptural doctrines such as the Trinity. This church, Newton believed, was the apocalyptic Babylon that would be destroyed by Christ at his second coming, opening up the way for the restoration of the primitive monotheistic Christian faith.

As in his study of nature, Newton approached much of his study of Scripture methodically. This is never truer than his exposition of biblical prophecy. His treatise on the Apocalypse from the 1670s begins with a series of "Rules for interpreting the words and language in Scripture". These rules had particular import for interpreting prophecy. His second rule of interpretation reads: "To

assign but one meaning to one place of scripture, unless it be perhaps by way of conjecture, or where the literal sense is designed to hide the more noble mystical sense as a shell the kernel from being tasted either by unworthy persons, or until such time as God shall think fit". Rule five commences: "To acquiesce in that sense of any portion of Scripture as the true one which results most freely and naturally from the use and propriety of the Language and tenor of the context in that and all other places of Scripture to that sense".

Thus Newton compared Scripture with Scripture and determined universal meanings for certain key prophetic symbols such as the sun (representing ruling powers) and beast (presenting empires). Newton's prophetic rules closely parallel the natural philosophical method Newton later developed in the *Principia*, including his emphasis on the parsimony principle (Ockham's razor) and his belief that once a phenomenon in nature had been established, it applied universally throughout nature. For Newton, Scripture and nature were written by the same Author, who was a God of order and not confusion, and thus similar interpretative strategies should be employed for both.

Newton also crafted several apocalyptic charts as part of his effort to interpret the symbols and time periods of the book of Revelation. He sent one of these charts to his friend the philosopher John Locke, with whom he often discussed biblical theology. The existence of this chart helps put to rest the Enlightenment myth of these two men as the twin pillars of the secular Age of Reason. Newton's extensive prophetic researches were unknown to the world at large until the posthumous publication by Newton's half-grand-nephew of the *Observations upon the prophecies of Daniel, and the Apocalypse of St. John* (1733). Little known outside certain Protestant circles, this work was often cited by Protestant historicist exegetes in the nineteenth and twentieth centuries. Newton's status as an icon of the Enlightenment notwithstanding, the *Observations* played a bit part in the development of Protestant fundamentalism.

The "Origines"

The mid- to late 1680s were an especially productive period for Newton. Not only did these years see the composition of the famous *Principia* and one of Newton's most important prophetic treatises, but it also saw the writing of his monumental "Theologiæ gentilis origines philosophicæ" ("The Philosophical Origins of Gentile Theology"). In this long and complicated Latin manuscript, Newton writes about a primitive monotheistic Ur-religion practised by Noah and his family that was gradually corrupted into idolatry by the pagan nations. Periodically, God brought about reformations that restored this original belief in the oneness of God, the two most notable being those initiated by Moses and Christ. In addition to explaining the origin of idolatry and polytheism, Newton also posits the belief that many of the early nations, including the Jews, acknowledged the heliocentric solar system in the architecture of their temples or prytanaea, which were constructed around central fires that represented the sun. In the Jewish Tabernacle and Temple, the altar of burnt offerings was this central fire.

In an English manuscript related to the "Origines" that dates from the early 1690s, Newton wrote: "as the Tabernacle was contrived by Moses to be a symbol of the heavens (as St. Paul and Josephus teach) so were the Prytanaea amongst the nations". In the same manuscript, Newton elaborates on the purpose of the ancient temples:

> So then 'twas one design of the first institution of the true religion to propose to mankind by the frame of the ancient Temples, the study of the frame of the world as

> the true Temple of the great God they worshipped. And thence it was that the Priests anciently were above other men well skilled in the knowledge of the true frame of Nature and accounted it a great part of their Theology.

Thus for Newton the ancients combined religion and the study of nature, with the latter being "a great part" of the former. The ancient priests, such as the Persian magi and the Chaldeans of Babylon, were at once astronomers and theologians.

Newton believed that the primeval religion could be reduced to two fundamental principles: the love of God and the love of neighbour. These are the Two Greatest Commandments articulated by Christ in the New Testament (Matthew 22:34-40) and Newton often repeated them in his private writings. It is significant that this primeval religion for Newton also involved an empirical, monotheistic natural theology. In his posthumously-published *Chronology of Ancient Kingdoms Amended* (1728), he brings these elements together:

> ... *the believing that the world was framed by one supreme God*, *and is governed by him*; *and the loving and worshipping him*, *and honouring our parents*, *and loving our neighbour as our selves*, *and being merciful even to brute beasts*, is the oldest of all religions.

This expression of belief in a *prisca theologia* provides yet another example of the powerful primitivism that permeated his religious and natural philosophical thought.

A SCIENCE THAT LEADS TO GOD

The Design Argument

Newton's career in natural philosophy demonstrates that he took the example of the ancient magi and Chaldean astronomer-priests as prescriptive for his own role. It is thus not surprising that Newton was a passionate advocate of natural theology and the argument from design. Already in his undergraduate notebook of the 1660s, Newton was musing about one argument from design: the bipartite symmetry in the physiological structure of humans and animals. In his 1692-1693 letters to Bentley, Newton argued that the well-ordered structure of the solar system bespeaks the creative hand of God. Bentley had sought Newton's assistance when writing up his Boyle lectures for publication. These lectures constitute not only the first significant English-language popularization of the physics of the *Principia*, but also comprise the first public use of Newton's physics to contend for the existence of an omniscient and omnipotent deity.

In his letters to Bentley, Newton argued that the complicated system of planets, which moved in the same direction on the same plane, when combined with comets moving in every direction and at every angle around the sun, implied design rather than chance. "To compare and adjust all these things together in so great a variety of bodies", Newton writes, "argues that cause to be not blind and fortuitous, but very well skilled in Mechanics and Geometry". He also argued that the various planetary systems in the universe would all fall together towards the middle of the universe through the power of gravity "without a divine power to conserve it", suggesting that the universe is upheld through the continuous operation of Providence. This conforms to what Gregory wrote after his visit to Newton in 1694, namely that the latter believed that "a continual miracle is needed to prevent the Sun and the fixed stars from rushing together through gravity".

Newton's natural theology does not portray the clockwork universe often associated with Newtonianism, but a powerful God of dominion akin to the view of divine Providence espoused by John Calvin, who wrote that by Providence he meant "not an idle observation by God in heaven of what goes on in earth, but His rule of the world which He made; for He is not the creator of a moment, but the perpetual governor". Newton need not have obtained this conception of Providence directly from Calvin. Like the French Reformer, he could see this view of God's sovereignty over nature in the Bible itself.

Although the first edition of his *Opticks* (1704) contained no overt natural theology, a surviving manuscript draft preface for this first edition demonstrates that he contemplated including assertions of natural theology at the beginning of the work. The draft preface contains a statement contending that God is a "principle in Philosophy" (by which he means natural philosophy) and that one of the best arguments in favour of a infinite, eternal, omniscient and omnipotent God is "the frame of nature and chiefly the contrivance of the bodies of living creatures". Thus by "principle in Philosophy", Newton means not that God is an axiom of natural philosophy proffered in *a priori* fashion, but a principle at which natural arrives through inductive means.

When Newton added several queries to the 1706 Latin translation of the *Opticks* (a translation carried out by the Newtonian Samuel Clarke), he made explicit the argument from design that was already present in the draft preface. In the query that became Query 28 in the second English edition of 1717, he attacks the mechanical philosophy of men like Descartes, whom he charges with banishing non-mechanical causes from natural philosophy, "feigning Hypotheses for explaining all things mechanically, and referring other Causes to Metaphysicks: Whereas the main Business of Natural Philosophy is to argue from Phænomena without feigning Hypotheses, and to deduce Causes from Effects, till we come to the very first Cause, which certainly is not mechanical". By this, of course, Newton means God.

Newton employs stronger language in relevant unpublished manuscripts, where he uses an empirical natural theology to attack atheism. In a manuscript draft of Query 28, he asserts that "arguments for a Deity if not taken from Phenomena are slippery and serve only for ostentation". Near the end of this draft he writes:

> We see the effects of a Deity in the creation and thence gather the cause and therefore the proof of a Deity and what are his properties belongs to experimental Philosophy. 'Tis the business of this Philosophy to argue from the effects to their causes till we come at the first cause.

Once again, Newton avers that an empirical study of nature will lead the student inductively toward God.

One of the backdrops to this polemic is Descartes' method, which began with God as an axiom. Newton was thoroughly convinced that inductive rather than deductive reasoning provided the most secure arguments for the existence of God from natural philosophy. Ontological arguments for the existence of God such as those used by Descartes are to be shunned; instead, as he writes in a manuscript from the early 1690s, "God is known from his works". Newton's study of "the frame of nature" (the structure of the universe) reinforced his belief that the universe was designed by God. He also believed the evidence uncovered by his natural philosophy would lead a unbeliever to belief. The British Newtonians Richard Bentley, William Whiston, Roger Cotes and others agreed, taking up their pens in defence of Newton's physico-theology and arguments from design.

Time and space

Philosophers of science have long been fascinated with Newton's distinction between absolute and relative time, space, place and motion—a distinction he makes in his Scholium on the Definitions in the *Principia*. With respect to time, he writes: "Absolute, true, and mathematical time, in and of itself and of its own nature, without reference to anything external, flows uniformly and by another name is called duration", whereas "relative, apparent, and common time is any sensible and external measure (precise or imprecise) of duration by means of motion; such a measure—for example, an hour, a day, a month, a year—is commonly used instead of true time". Similar distinctions are made between absolute and relative space, place and motion. For Newton absolute space is immovable and it provides his physics with an absolute (unmoving) frame of reference against which relative motion occurs, just as his conception of absolute time provides him with an absolute temporal frame of reference against which relative time occurs.

Like so much of his natural philosophy, Newton's views on absolute time and space are closely tied to his theology and in particular his conceptions of God's temporal and spatial ubiquity. An unpublished manuscript believed to date from the early 1690s provides insight into Newton's theology of time and space. God's eternity is not "all at once" but rather, building his case on the language of Revelation 1:8, God is "the one who was and is and is to come". In other words, God's eternity is not timelessness or a point on an arrow moving infinitely into the future; instead, God's eternity fills past, present and future time. His temporality is infinitely extended. In conceiving of God's eternal duration in this way, Newton is beginning to think of time as a dimension. The same manuscript shows that Newton believed that God is not localised in any way, but rather is infinitely extended and perfectly omnipresent. Thus God fills space just as he fills time.

It is possible to be even more precise. Newton saw a direction association between God's eternal duration and infinite extension on the one hand, and absolute time and space on the other. For Newton, the latter were predicates of the existence of the former. A manuscript list of twelve statements distinguishing God from Christ according to his biblical unitarian theology both confirms this association and reveals that it has a heretical corollary. In this manuscript Newton asserts that it is only the Father who is "ever-living" and "immoveable". Christ is excluded from these uniquely divine attributes. While Newton believed that only philosophers were aware of the distinction between the absolute and the relative, a *Principia*-related manuscript dating from between 1684 and 1686 also hints that Newton believed that ultimately only the omnipresent and omniscient God can really distinguish absolute motions from apparent motions. An awareness of these theological backdrops is crucial to an understanding of Newton's influential conception of absolute time and space.

The General Scholium

Newton's agendas in natural philosophy and theology come together in the General Scholium, which he added to the second edition of the *Principia* in 1713. This tightly-written text begins with a polemical statement directed against the fluid vortices of Descartes, which are rendered untenable in the face of empirical evidence that comets move in every direction and at every angle around the sun. From there he moves on to discuss the structure of the solar system and the movement of bodies

in the solar system without resistance according to the law of gravity. He then returns to one of the arguments from design he raised in his letters to Bentley, namely that a purely mechanical cause could not have produced a system that both includes planets moving in the same direction on the same plane and comets that "go freely in very eccentric orbits and into all parts of the heavens".

Instead, Newton proclaims that "this most beautiful system of the sun, planets, and comets could not have arisen without the design and dominion of an intelligent and powerful being". For Newton both the initial design of an intelligent God and the dominion of a powerful Being are required for the universe he observed. The stress on the continuous sovereignty of God is in part a slight against the deists. His very next statement makes an additional point: "And if the fixed stars are the centers of similar systems, they will all be constructed according to a similar design and subject to the dominion of *One*, especially since the light of the fixed stars is of the same nature as the light of the sun, and all the systems send light into all the others". For Newton there is a direct relationship between the unity of God and the unity of creation. He next argues that the placement of the stars at immense distances from each other offers another example of design and foresight, as this layout prevents the stars from falling together as a result of gravity.

At this point Newton launches into a majestic description of the God he found in Nature and Scripture. This Being, Newton begins, "rules all things, not as the world soul but as the lord of all. And because of his dominion he is called Lord God *Pantokrator*". Then follows an account of God's eternity and omnipresence that is shot through with biblical language. Newton's God is sovereign over time and space. This twofold sovereignty, Newton suggests, ultimately underpins all things in time and space: "All the diversity of created things, each in its place and time, could only have arisen from the ideas and will of a necessarily existing being". Once again we see the emphasis on both God's mind and will. At the end of the explicitly theological section of the General Scholium Newton writes: "This concludes the discussion of God, and to treat of God from phenomena is certainly a part of experimental philosophy" (changed to "natural philosophy" in the 1726 third edition of the *Principia*). Thus for Newton discussions about God and design are not to be kept separate from natural philosophy, but rather are integral to it.

After making this bold statement, Newton describes the phenomenon of universal gravitation. As to the cause of gravity, Newton implies that he does not think that it is mechanical, but states that he does not want to attempt to posit a cause, declaring "I do not feign hypotheses" (*hypotheses non fingo*). Although this famous declaration fits into his attempt to provide a mathematical *description* of gravitation instead of an argument for its ultimate cause, his foregoing discussion of God's ubiquity in space provides an internal hint that he believes that God is ultimately behind it the phenomenon. After all, the only two things Newton speaks about as being spatially universal are God's omnipresence and gravitation. Whether or not Newton is publicly hinting at this conclusion in the General Scholium, it is now know that this was a conclusion he strongly contemplated in private.

Many readers of the General Scholium were able to discern the natural theological arguments contained therein. Far fewer recognised the coded attack against the Trinity that Newton wove into this text. In his discussion of God's attributes of eternal duration, omnipresence and unchallenged dominion, he asserts that the term "God" is a relative term that derives its meaning from God's dominion over servants. The unmentioned backdrop to this assertion is a contemporary debate in which Trinitarians argued that the term "God" denotes divine substance and essence, while

Unitarians insisted that the term primarily refers to power and dominion. Newton, like other antitrinitarians of his period, cites Exodus 4:16, Exodus 7:1, Psalm 82:6 and John 10:35 as evidence that humans are called "god" in the Bible in an honorific or official sense when they act as God's representatives.

Although the corollary that in the handful of times Christ is called God in the Bible these examples, too, should be read in an honorific sense is not made explicit in the General Scholium, Newton's unpublished theological papers confirm that this is what Newton believed. Even without an explicit clarification, Newton's argument was understood by those few of his readers familiar with the debates then raging between Trinitarians and Unitarians. In the General Scholium, Newton takes the side of the persecuted latter party. The second and third editions of the *Principia* thus conclude with an attack on the central dogma of the institutional church. In composing the General Scholium, Newton adopted the Pythagorean style that he wrote about two decades earlier in the Classical Scholia, hiding the higher truths from the common people, while providing enough clues for his adept readers to discern his true meaning.

A unified system

For some time students of Newton's thought have been willing to conclude that there was a weak relationship between Newton's science and his religion. It has long been clear that Newton's piety and commitment to natural theology helped to stimulate his work in natural philosophy and allowed him to find greater satisfaction in it. But increasingly scholarship is pointing to examples that suggest that a strong relationship existed between his science and his religion, namely, that some of Newton's religious ideas helped to shape the cognitive content of his natural philosophy (and *vice versa*). The increasing availability of Newton's unpublished manuscripts means that Newton's natural philosophical writings are no longer separated from his unpublished theological papers. When studied together, they point to the unity of Newton's thought.

While Newton did recognize disciplinary distinctions, he held to a powerful belief in the unity of truth. That he thus believed can be explained in large part by his commitment to the doctrine of the Two Books. For Newton as for many of his theist contemporaries, God wrote both the Book of Nature and the Book of Scripture. As Newton did not believe God was the author of confusion, he concluded that there must be a fundamental unity between Creation and the Bible and thus between natural philosophy and true theology. This unity extended in part to method. Thus several scholars have recently pointed to methodological links between Newton's empirical natural philosophy and his empirical biblical hermeneutics.

These relationships exist not only between Newton's natural philosophy and theology in a general sense, but between his natural philosophy and his unique heretical theology. Just as he believed that failure to distinguish between the absolute and relative in physics could lead to errors, so he concluded that the failure to distinguish the relative meanings of the term "God" from God's absolute reality led to the doctrinal error of the Trinity. Newton's belief in the oneness of God forms another bridge, underpinning on the one hand his biblical unitarian faith and on the other his belief in the unity of natural phenomena. It is the One God, who exists everywhere, who makes universal gravitation possible.

Newton's antitrintarianism and other theological unorthodoxies created great distance between him and the majority of his contemporaries. Celebrated universally today as one of the

greatest scientists of all time, in his own day Newton was isolated by his agile mind and radical religious non-conformity. Although he believed biblical prophecy indicated that the religious reformation to restore primitive Christianity would not occur until at least two centuries after his death, he did publish oblique hints about the original religion he longed to see restored. In addition to the General Scholium, Newton inserted some suggestive words about this at the end of Query 31 of the *Opticks*—words that thus come at the end of this great work of science.

> The antepenultimate and penultimate sentences of Query 31 read:
>
> And if natural Philosophy in all its Parts, by pursuing this Method, shall at length be perfected, the Bounds of Moral Philosophy will be also enlarged. For so far as we can know by natural Philosophy what is the first Cause, what Power he has over us, and what Benefits we receive from him, so far our Duty towards him, as well as that towards one another, will appear to us by the Light of Nature.

The light of nature, Newton contends, will illuminate the two chief principles of the primeval religion: the love of God and the love of neighbour. In addition to the Bible, the study of nature should lead humanity to God and to altruistic action. Along with the central tenet of God's oneness, these principles formed part of Newton's agenda for his natural philosophy. Just as the Book of Scripture speaks of the oneness of God and two core ethical principles, so does the Book of Nature.

In the final sentence of Query 31 Newton contends that if the pagan Gentiles had not been led astray by idolatry and polytheism, "they would have taught us to worship our true Author and Benefactor, as their Ancestors did under the Government of Noah and his Sons before they corrupted themselves". Thus he concludes the later editions of the *Opticks*, shedding light on the dual reformation that he wrote about in his private manuscripts and, apart from published hints such as this, kept from the prying eyes of the public. Newton's *Principia* and *Opticks*, therefore, were in part meant to reform natural philosophy from its corruption and restore it to its original purity as a science that leads to God.

Published in *Science, Religion, and Society: An Encyclopedia of History, Culture, and Controversy*, 2 vols., ed. Arri Eisen and Gary Laderman. Armonk, New York: M.E. Sharpe, 2007, vol. 1, pp. 355-69.