The Word and the World

Biblical Exegesis and Early Modern Science

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Introduction: The Word and the World

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> I, Galileo, being in my seventieth year a prisoner on my knees, and before your Eminences having before my eyes the Holy Gospel, which I touch with my hands, abjure, curse, and detest the error and the heresy of the movement of the earth.

Galileo's recantation before the ecclesiastical authorities in 1633 of his defence of the Copernican theory of a heliocentric universe is an iconic scene in the saga of putative conflict between religion and science, though it is also a scene whose meaning has been the subject of much debate.[1] The 'emergence of science' in the late Renaissance is a story that has often been told in such dramatic terms as the sloughing off of dogma and turgid scripturalism by anti-authoritarian thinkers heroically struggling for intellectual liberty. While Thomas Kuhn famously and proficiently muddied the waters in terms of the pace of the 'Scientific Revolution', and while other scholars have presented a more complex relationship between the two protagonists, science and religion, the picture remains, by and large, one of dawning clarity, in which a biblical myopia is replaced with a view of the world less textually hidebound, with science cast as the enlightened man emerging from Plato's cave.[2]

This collection of essays presents a series of instances in the sixteenth and seventeenth centuries in which biblical interpretation functioned not to silence or negate the operations of science, but in which natural philosophy emerged from and was imbricated with the practices of biblical exegesis, the hermeneutic methods traditionally employed by theologians investigating the meaning of scripture. The central issue is seen as a negotiation over the standards to be applied to the

interpretation of texts, a problem shared by natural philosophers and theologians alike. Sometimes this involved attempts to view the words of scripture through the lens of natural philosophy, and the belief that biblical events were explicable in physical, scientific terms; at other times it was deemed possible to read the natural world aided by (or at least not contradicted by) the biblical text, codex of the secrets of God's creation. This symbiotic, if awkward, *quasi*-hermaphroditic relationship – science being used to substantiate the Bible and the Bible being used to legitimise science – is one that is repeatedly demonstrated across a range of early modern writing on the natural world.

The premise of the collection is that the natural philosophy of the era, far from being at implacable odds with the Bible and the Church, is better characterised by its willingness and desire to marry scripturalism with its study of the natural world. Robert Boyle (1627–1691), a devout Protestant and one of the founders of the Royal Society, at the forefront of English experimentalism, writes of the necessity that natural philosophy give 'a close and critical account of the more vail'd and pregnant parts of Scripture and Theological Matters'.[3] One of Calvin's students, the theologian Lambert Daneau (1530–1595), writing a century earlier, promoting a 'Christian' natural philosophy as a replacement for pagan Aristotelian physics in his *Physica christiana* (1576), argues with heavy irony: 'Moses … is either a vaine fellowe or a lier, if that knowledge of Natural Philosophie be not conteined in the holy scripture.'[4] Throughout Europe, in both the Protestant North and Catholic South, the centuries immediately following the Reformation witnessed an intricate series of attempts by natural philosophers to interpret nature and scripture as mutually illuminating, both of them containing a plenitude of knowledge for the benefit of mankind and the glorification of God. One of the best-known examples is Galileo's clever interpretation of the biblical account of the Sun standing still (Joshua 10:12) in his 1615 letter to Christina of Lorraine, Grand Duchess of Tuscany, 'Concerning the Use of Biblical Quotations in Matters of Science', to demonstrate how astronomical observation 'agrees exquisitely with the literal sense of the sacred text'.[5] Admittedly his combination of telescopic observations and liberal biblical interpretation earned him the censure of conservative Catholic authorities and provoked an intramural dispute over the proper principles of biblical interpretation, but this should not be taken to imply there was a subsequent decrease in interest among Catholics in harmonising the two realms.[6] The Dominican philosopher and theologian Tommaso Campanella (1568–1639), who defended

Galileo's freedom of thought despite disagreeing with his conclusions, forcefully declares:

> Anyone who forbids Christians to study philosophy and the sciences also forbids them to be Christians … Every human society or law which forbids its followers to study the natural world should be held in suspicion of being false. For since one truth does not contradict another, … and since the book of wisdom of God the creator does not contradict the book of wisdom of God the revealer, anyone who fears contradiction by the facts of nature is full of bad faith.[7]

The evidence of the essays collected here does not suggest that scientists necessarily found themselves oppressed by the shadow of biblical authority. Rather, there is a supposition of constructive dialogue between scripture and natural world and a broad assumption among scientists that their truths were reconcilable. While natural philosophers, many of whom were themselves churchmen, often, though, of course, not always, took the Bible to be their province, theologians frequently proved more wary of the interweaving of natural philosophy with biblical analysis. One of Boyle's contemporaries, the nonconformist minister George Hughes (1603–1667), in *An Analytical Exposition of the Whole First Book of Moses* (1672), depicts a scholarly scientific community which would be shocked at the idea of discussing the biblical creation *without* framing it in scientific terms, and he worries that if his book should:

> fall into the hands of a supercilious Philosopher he may think it strange and possibly be angry too the author should passe over the 3 first Chap [of Genesis] and not produce his Cabbala and vent some new Hypothesis to the World, or side with and plead for some already started in it, determining which of them had most right to rule it, whether the Ptolomeick Copernican or that of Tycho, as likewise what body of Physicks should by a divine right take place and be entertained, either the elementary, the Globular, or the newly revived Corpuscularian. And that great Phainomenon be resolved whether Moses were not altogether Cartesian.[8]

Readings of the Book of Genesis, indeed, form the backbone of this collection, as was the case in many of the encounters between science and scripture. The *hexaemera*, commentaries on the biblical account of the first six days of creation, were an important source of natural

philosophy in the Middle Ages, and were a case when science was seen as a useful instrument for interpreting the scriptural record.[9] In this respect, the contributions of Greek science had been an important component of the Christian world view from the time of the early Church Fathers, such as Clement of Alexandria (d. *c.* 215) who considered the contributions of Greek philosophy essential for the defence of the faith against heresy and scepticism and for the development of Christian doctrine. In his commentary on the first two verses of Genesis in the *Confessions*, Augustine (354–430) managed to squeeze roughly 9000 words of commentary from a text that runs to a mere seventeen words,[10] and about a year later in *The Literal Meaning of Genesis*, he set down basic procedures for the application of science to the creation account that were to have a profound influence on exegetical practices in the Middle Ages and Reformation. These procedures were underlain by Augustine's concern that Christian argument should not leave itself open to ridicule in debate with pagan philosophers:

> Whatever they can really demonstrate to be true of physical nature, we must show to be capable of reconciliation with our Scriptures, and whatever they assert in their treatises which is contrary to these Scriptures of ours, that is to Catholic faith, we must either prove as well as we can to be entirely false, or at all events we must, without the smallest hesitation, believe it to be so.[11]

These ideas were faithfully summarised by Thomas Aquinas (*c.* 1225–1274) in his own commentary on the six days of creation in the *Summa theologiae*. While Aquinas considered theology the highest science because of its reliance on biblical revelation, he did not disregard the secular sciences of natural philosophy, which had value as the 'handmaiden to theology' for the assistance it could provide for the interpretation of the divine word. Since the master of arts degree, incorporating the study of Aristotle's logic and physics in its curriculum, was usually a prerequisite for entry into the higher faculty of theology, most medieval exegetes were well acquainted with the science of their day and able to relate natural philosophy and theology with relative ease, be that the application of science to scriptural exegesis or the citation of verses of scripture in support of scientific theory. These intellectual presumptions did not disappear with the Reformation but remained at work well into the 'Scientific Revolution'. The sweeping range of natural philosophy that Hughes describes above is telling, for it points to the magnitude of early modern scientific endeavour forged not in opposition to the Bible,

but with the aim of displaying a unity between these spheres of knowledge. These endeavours span the spectrum of scientific enquiry in the period: from the Cartesian to the atomistic, from the astronomical to the geological, from Cabala to natural history. Far from being implacable enemies, science and scripturalism seem to have been inextricably intertwined.[12]

The critical literature examining the relations of religion and science is rich, varying from Victorian polemic on the history of antagonism between them – most famously promulgated by John William Draper (1811–1882) in *History of the Conflict between Religion and Science* (1874) and Andrew Dickson White (1832–1918) in *A History of the Warfare of Science with Theology in Christendom* (1896) – to accounts which posit no essential discordance, such as the apologetic discourses of the Protestant historian Reijer Hooykaas and the Catholic priest-scientist Stanley L. Jaki. Between these poles, historians have registered the many forms of uneasy, productive or localised interaction. Within the early modern period, the practice of 'physico-theology', for example, in which the natural world was a didactic treasure trove of religious teaching, was one among many efforts to harmonise the fields.[13] The essays here are not, however, focused on science and religion, *per se*. Rather they address a more apparently incompatible set of practices: biblical exegesis and science. They explore how the protocols of biblical hermeneutics affected thinking on natural philosophy. The cumulative effect of the essays is, by no means, to suggest a homogeneity in exegetical approach – there are clear variations throughout Europe, between denominations and over time – but they do demonstrate that exegesis was a prominent consideration in attempts to understand the natural world. Exegesis, it could be argued, was one of the crucial cultural activities of the early modern era, its effect traceable across a range of thought – from law to politics, poetics to philosophy – for all that such biblicism has been occluded, by and large, in the historiography of the Scientific Revolution. The obverse is also significant: the critical history of exegesis has not paid much detailed attention to issues beyond the histories of doctrine and philology.[14] Exegesis, however, had a far broader remit than the boundaries of divinity and the familiar touchstones of political-denominational dispute. The Bible underwent relentless annotation, explication and amplification, often verse by verse, that addressed every aspect of its cultural, geographical and metaphysical background, including discussion of and widespread belief in the scientific content in its pages.

First appearing in 1999, Peter Harrison's *The Bible, Protestantism and the Rise of Natural Science* sets forth the compelling if provocative thesis

that far from being an impediment to the emergence of science, the Protestant call for a return to literal interpretation provided the intellectual conditions and the hermeneutic mode conducive to the development of science. Harrison notes how the idea of biblical literalism as the begetter of scientific habits of thought is somewhat counter-intuitive, that we tend to consider literal understanding of the scriptures as antithetical to objective scientific procedure. This preconception has it that a new 'scientific' or empirical way of looking at the world caused people to reject the Bible. Rather, he suggests, the reverse was true: 'When in the sixteenth century people begin to read the Bible in a different way, they found themselves forced to jettison traditional conceptions of the world'. Out of this change in interpretative habits, he argues, emerged a scientific consciousness.[15] His essay here both restates and extends that thesis. Harrison's argument is in many ways the point of departure for the essays collected here, but the terms of his investigation are subject to close critique in a number of the essays, which in varying degrees present, if not antithesis and synthesis, at least some parenthesis, disputing, refining and owing much to his still recent reconfiguration of scriptural hermeneutics and the emergence of science.

While literal interpretation of the Bible is an affront to any modern scientific procedure, it is fair to say that in the early modern era, it was a standard and accepted basis for thinking about the physical world in both Catholic and Protestant thought. Histories of biblical interpretation characterise Catholic biblicism by its adherence to the *quadriga*, the medieval fourfold method of interpretation by which a biblical text can, theoretically, be understood to provide various meanings simultaneously: historical or physical (*Literal*); doctrinal or credal (*Allegorical*); moral (*Tropological*); and a soteriological or eschatological sense (*Anagogical*).[16] Harrison's thesis explores how the emergent Protestant emphasis on a hermeneutics of the literal altered conceptions of the natural world, though it should be noted that Catholic approaches to the Bible were by no means a stable entity either and engaged readily with reformed exegesis. The Protestant rejection of the Catholic position that only the Church interprets the Bible set the two sides in direct opposition, forcing the Roman Catholic church to definitively determine its doctrine. The Council of Trent (1545–1563) established the canon of the Old and New Testaments, chose Jerome's Latin Vulgate as the authoritative edition of the Bible and ordained that matters of interpretation were to be referred to the tradition of patristic exegesis.

Thus, while for Protestants, literal interpretation sprang from faith in the inerrancy of the plain, grammatical text, for Catholics, literal

meaning found legitimacy in the authority of previous interpreters. One consequence of this was a firmer, more literalistic stance, and consequent restriction in hermeneutic freedom, in contrast to the broader, more liberal approach of the late Middle Ages; but this is not the whole story. A number of the essays here interrogate the very nature of literalism, challenging the boundaries of the interpretative map on which literal interpretation is represented as characteristic of Protestantism, leaving allegory as the default hermeneutic mode of post-Reformation Catholicism. James Fleming's essay, for example, addresses the central terms of Harrison's thesis, exploring the parameters of 'literal' interpretation and finding a set of exegetical difficulties, if not absurdities, in a concept which should by its very nature be plain and transparent – the literal being that which presumably should not require 'interpretation' – according, for instance, to Calvin's assertion that for anyone who could read the plain, grammatical sense of the text, 'the true meaning of Scripture is the natural and simple one'.[17] That this was not so, in either Catholic or Protestant hermeneutics, explains why so much was invested in the literal. This elastic capacity around what constitutes literal interpretation – that is, reference to the physical world – is crucial to its role in early modern science, as, indeed, it was to patristic interpretation, most evidently in Augustine's well-known statement (in *On Christian Doctrine*) endorsing the study of natural philosophy for the purpose of biblical interpretation:

> In the same way I can see the possibility that if someone suitably qualified were interested in devoting a generous amount of time to the good of his brethren he could compile a monograph classifying and setting out all the places, animals, plants, and trees, or the stones and metals and all the other unfamiliar kinds of object mentioned in scripture.[18]

The collection, then, does not posit any central thesis about what is distinctive to Catholic and Protestant exegesis, beyond the fact that natural philosophers across denominations aimed to integrate and find an accommodation between their science and their scriptural interpretation. This is a process evident even in such a figure as Francis Bacon (1561–1626), often seen as a talisman of the apparent secularisation of natural philosophy in the era. Steven Matthews' essay demonstrates the extent to which Bacon utilises the protocols of biblical interpretation in his natural philosophy. Depicting the depth of Bacon's reference to scripture across his work, Matthews queries a long-standing tradition of

historiography in which Bacon is said to delimit and separate the roles of theology and natural philosophy. Though a number of apparently clear statements of this separation might seem to settle the matter, Bacon's practice suggests a far more subtle interaction. Moreover, theology and exegesis are not one and the same, and he continues to make extensive reference to scripture within his natural philosophy.

If the Royal Society adopted Bacon as their role model for separating religion and science, another scientific luminary, Robert Boyle, born the year after Bacon's death, nonetheless praises him precisely on the grounds of his exegetical acuity. Boyle remarks, 'I meet with much fewer than I could wish, *who* make it their Business to *search the Scriptures*', and he notes as an exception to this Francis Bacon, whom he places in the company of the biblical and legal historian Hugo Grotius (1583–1645) and the apocalyptic chronologist Joseph Mede (1586–1638). Boyle describes Bacon's intellectual eminence as emerging from his being simultaneously a natural philosopher and a proficient biblical exegete, one who is 'at once a Philosopher, and a great Critick'. These comments also focus on the relationship between science and exegesis, the need to bring scientific proficiency to biblical exposition, which, Boyle continues, will only reach its fulfilment: 'when it shall please God to stir up persons of a Philosophical Genius, well furnish'd with Critical Learning, and the Principles of true Philosophy'.[19] Boyle's account insistently stresses not just a 'religious' motivation to the study of natural philosophy, but the *scriptural* character and the exegetical nature of one's approach to science. He does not argue that scientific truth is necessarily located in the scriptures, though he does claim that in Genesis, God 'is pleased to give nobler hints of natural philosophy than men are yet perhaps aware of',[20] arguing for a literal interpretation:

> I see no just reason to embrace their opinion, that would so turn the two first chapters of Genesis, into an allegory, as to overthrow the literal and historical sense of them, and though I take the scripture to be mainly designed to teach us nobler and better truths, than those of philosophy, yet I am not forward to condemn those, who think the beginning of Genesis, contains divers particulars, in reference to the origin of things, which though not unwarily, or alone to be used in physicks, may yet afford very considerable hints to an attentive and inquisitive peruser.[21]

Boyle emphasises the methodological parallels between interpretative strategies of world and word, whereby one source of truth – the study of

the natural world – will only be compounded and never contradicted by truth gleaned from the scriptures. That such a canonical figure in the history of science as Boyle can so resolutely signal the centrality of scriptural exegesis to natural philosophy, and that it has nevertheless been treated as antithetical to the emergence of science, points to something of a critical blind spot with regard to the Bible's historical influence on science – a testament to the enduring appeal of nineteenth-century conflict models between science and religion.[22]

The latter-day account of scientists struggling for philosophical autonomy from overbearing church structures, moreover, is a narrative that has tended to reduce early modern natural philosophy to two figures – the two Catholic astronomers, Copernicus (1473–1543) and Galileo (1564–1642) – who have come to stand by faulty synecdoche for the story of the emergence of science, ignoring the phenomenal breadth of interest in and enquiry into the natural world during the period. Without diminishing either, it can fairly be said that these paradigmatic, indeed totemic, figures do not constitute the whole of early modern astronomy, let alone the wider discipline of science, and that the legends that have accrued around them have obscured as much as clarified their significance for natural philosophy in the era. What is more, neither figure fulfils entirely the Whiggish conflict narrative in which the Bible served to blind the participants in the dispute to physical fact. Kenneth J. Howell, in *God's Two Books: Copernican Cosmology and Biblical Interpretation in Early Modern Science*, tracing the reception history of Copernicanism in Protestant Europe, presents a labyrinthine and international picture across Continental Europe, challenging any neat division between scientific truth and obstinate biblicism. He argues that 'the common notion that the Bible functioned mainly as a deterrent to the acceptance of Copernicanism is very wide of the mark because both Copernicans and non-Copernicans viewed the Bible as offering truth about the physical universe, albeit in different ways' and he claims that the nature of the cosmological dispute cannot be understood without 'a more refined understanding of literal interpretation'.[23] It is the nature of the exegetical procedure that was at stake as much as arguments over physical fact and hypotheses. Similarly complex is the case of Galileo, notwithstanding his famous assertions regarding the proper divorce of the Bible from astronomy, which have come to stand as shorthand for the battle for scientific modernity, but which belies a much more complex engagement with scripture.[24] For all its importance, the prominence of the Galileo affair in both popular and scholarly accounts of the period, as a moment of beleaguered but brave

secularism, is a misrepresentation of the vibrant scientific landscape of the period, its breadth and variety and its ready engagement with the Bible.[25] This collection does not, of course, ignore the intellectual contributions of such eminent figures, but focuses also on other actors in the drama.

Another approach to clarifying the links between sacred and profane learning in the period has been to examine the specific religious allegiances of scientific communities. Most influentially, the 'Merton thesis' and its successors posit a direct relationship between Puritanism and the rise of science, arguing that aspects of the putative Puritan character were conducive to the emergent scientific community, so that 'the cultural soil of seventeenth-century England was particularly fertile for the growth and spread of science'.[26] Merton's image of science, however, is of a highly empirical, utilitarian endeavour, with a bias away from the theoretical contributions of figures like Galileo, Kepler and Newton who epitomise the Scientific Revolution. Such a notion of scientific communities emerging from doctrinal allegiance is suspect on a number of other grounds. It rests on the dubious idea that particular religious groups share common character traits, that, for example, Anglicans were predisposed to conjecture and probability rather than dogmatic assertion, or that their alleged 'moderation' (in contrast to the intransigence of others) was congenial to objectivity. Moreover, such an argument is distinctly Anglo-centred, addressing Protestant England as the gauge and benchmark for the emergence of science, relegating Continental Europe, both Catholic and Protestant, to a subsidiary role in the Scientific Revolution.[27] This was resolutely not the case. It is problematic, therefore, to posit either causal or circumstantial links between doctrinal beliefs and scientific proclivity. One's habits of exegesis, on the other hand (which may have some relation to, but are not the equivalent of, one's doctrinal position), provide specific models of thought at work in both scientific and scriptural approaches, closely related procedures in analysing both word and world.

It is, in any case, surely not possible to clarify what was distinctive about the emergence of Protestant science in isolation from Catholic procedures and presumptions. Consequently, a key avenue explored in this collection is the extent to which Catholic Europe and Catholic science were similarly engaged in marrying its exegetical procedures to their understanding of the physical world.[28] Paul Mueller's essay considers the works of one of the major promoters of the new Mechanical Philosophy, the Minim priest Marin Mersenne (1588–1648). He explores the role of biblical textual criticism in relation to early

modern science, finding that doubts about the text of the Bible were mirrored in approaches to the natural world, not only in the practice of Mersenne but also more widely among other Jesuit scientists. Following this consideration of one of the bastions of Catholic religious orthodoxy, Leo Catana's essay investigates one of its most unorthodox sons (in the realms of both science and religion), the Dominican priest Giordano Bruno (1548–1600), who ardently defended Copernican theory at Oxford in 1583, before a hostile audience of philosophers and theologians. In his *Ash Wednesday Supper* (1584), he presents a sarcastic humanist dialogue not simply refuting traditional arguments against the motion of the Earth, but asserting that God 'is glorified not in one sun, but in countless suns; not in one Earth or one world, but … in an infinity of worlds'.[29] As can only be fitting in a Bruno scholar, Catana takes a tangential approach to the idea of 'science', broadly interpreted as 'knowledge', and provides a close examination of the hermeneutics of Bruno's *De Monade* (1591), showing how, not satisfied with the traditional fourfold *quadriga*, Bruno discovers nine levels of meaning in his reading of the Bible and other divinely inspired texts.

Attention to Catholic science in the period necessarily focuses on the formidable reputation of Jesuit natural philosophy, a reputation matched by the loathing and fear of the Society of Jesus as a political force in the Protestant North. Founded in the early 1540s by Ignatius Loyola, at about the time of the convening of the Council of Trent and the publication of the two new maps of the macro- and microcosm, Copernicus's *De Revolutionibus* (1543) and Vesalius's *De Humani corporis fabrica* (1543), the Society of Jesus was one of the foremost intellectual elites of the seventeenth century. Volker Remmert's essay examines the writings of the German mathematician and astronomer Christoph Clavius (1538–1612) and his fellow professor at the Jesuit Collegio Romano, the Spanish natural philosopher and theologian Benito Pereira (*c.* 1535–1610), whose work demonstrates Jesuit openness to combining their exegesis with scientific thought in the sixteenth century. Clavius was an old friend and colleague of Cardinal Robert Bellarmine (1542–1621), head of the Collegio Romano in 1611 when it honoured Galileo for his telescopic discoveries. This was the same Bellarmine, of course, who was author of the preface to the Clementine Vulgate of 1592 (the very symbol of Tridentine authority), and a member of the commission that tried and convicted Bruno of heresy in 1599. In the 1580s, debates over educational policy came to a head with the promulgation of the *Ratio Studiorum*, of which Clavius was a primary author. Looking in particular at responses to the Copernican theory of terrestrial motion

and debates around the number of the stars, Remmert shows how such debates invoke both astronomical and exegetical support. He was actively engaged in the debate over the degree of certitude to which astronomy could aspire in constructing true explanations. In his authoritative textbook, which became the standard of the Jesuits, Clavius argued that astronomy, like physics, was concerned with true causes. Galileo's astronomical lectures at Pisa were largely paraphrases of his friend Clavius's *Commentary on the Sphere of John of Sacrobosco*, in the last edition of which Clavius included a brief reference to Galileo's telescopic discoveries.

Irving Kelter extends the case made by Remmert for the importance of Catholic exegesis, and looks at the the Dutch humanist Cornelius Valerius (1512–1578), Professor of Latin and one of the lights of the great Trilingual College of the University of Louvain in the sixteenth century. Valerius composed a number of successful textbooks on ethics, dialectics, grammar and a variety of scientific subjects. Kelter's essay focuses on Valerius's method and thought in the areas of natural philosophy and the mathematical sciences, looking at two of his publications from the 1560s, in which he developed a Mosaic, biblical cosmology and contrasted it with the non-Christian ideas of ancient philosophers, including Plato and Aristotle. Having introduced Valerius, Kelter then compares his ideas to other Catholic exegetes: Cardinal Robert Bellarmine; Prince Federico Cesi (1585–1630), founder of the Accademia dei Lincei; and the Spanish humanist, philosopher and physician to Philip II, Francisco Vallés (1524–1592). Together, these essays present a wide landscape of Catholic scientific thought, complementing the more thoroughly developed historiographical attention to Protestantism and the rise of science.

This book, then, proceeds from the idea that it is biblical exegesis, rather than religion more generally, that is the crucial historical factor differentiating early modern debate on science and religion from its nineteenth- and twentieth-century equivalents. Perhaps the most prominent early modern (though also medieval) expression of the interaction between religion and natural philosophy is the trope of the 'Two Books', according to which God has provided two routes to his ineffable truths: scripture and creature, the Bible and the World. This metaphor is an almost ubiquitous prelude to discussion of the natural world in the era. The two books metaphor is routinely cited as a rationale for the study of nature, as well as serving to explain the existence of the morality of pagans, God having written into nature the same truths to be found in scripture.[30] The English physician Thomas Browne

(1605–1682) notes: 'there are two Books from whence I collect my Divinity; besides that written one of God, another of His servant nature, that universal and publick Manuscript, that lies expans'd unto the eyes of all; those that never saw Him in the one, have discover'd Him in the other ... Surely the Heathens know better how to joyn and read these mystical Letters than we Christians, who cast a more careless Eye on these common Hieroglyphicks and disdain to suck Divinity from the flowers of Nature.'[31] Campanella goes so far as to reverse the order of priority: 'The first Codex, whence we obtain sacred knowledge, was the nature of things. But when this did not prove sufficient for us, as we on account of our sins are given over to ignorance and negligence, we required another Codex, more appropriate for us, although not better. For better is that one of nature, inscribed in living letters than that of Scripture written in dead letters, which are only signs, not things, as set forth in the earlier Codex. Nevertheless for the sake of our knowledge at least the Codex of divine Scripture is better because it is easier to understand.'[32] In this early modern metaphor, nature is a respectable 'source' of divinity, although it is in conjunction with scripture that it is most properly to be understood, rather than independently.

There is, however, something disingenuous in the *critical* usage of the idea of 'God's Two Books' and how historians of science have interpreted the notion, which goes to the heart of the debates over the interaction of science and religion. Although many models have been proposed for how religion manifested itself in the growth of science, reading the Bible and in particular 'taking the Bible literally' are treated, with few exceptions, as wholly antithetical to the emergence of a modern conception of nature. They are frequently associated with a near-perverse and resolute refusal to look at the 'facts', to do other than maintain one's gaze on the surface meaning of the biblical account. Even among critics who aim to establish a positive link between science and religion, strict adherence to the literal sense is seen as the retrograde wing of religious thought, while scientists themselves are depicted as religious in every sense except the exegetical. The trope of God's two books ends up being reduced to something of a fig leaf, simplistically presented as a pious disguise on the part of scientific thinkers to lend their 'real' studies a legitimising halo of religious respectability. This study is premised on the idea that the *scriptural* (rather than the *religious*) element in the emergence of modern science has been largely ignored in much early modern historiography. When early modern writers wrote of the importance of the two books, they meant precisely what they said – it was not a surrogate or a synecdoche for religion in general, but a clear indication of the role of exegesis.

As historical studies, the essays here describe one or two less well-trodden places in the scientific landscape of the era, without premising their explorations on presentist considerations of whether or not the figures are practising 'good' science. In a sense, the historical reliance on the Bible almost predetermines that the science, *qua* science, is irredeemably flawed. The days have, however, passed (one would hope) when historians of science held to the bone-deep Whiggish view that saw the story of science as one of inevitable progress and that accorded its greatest interest only to those historical elements which won out over and displaced rival theories.[33] Indeed, it is the alien nature of the past, its different categories and relations between ideas, that constitutes much of its fascination. Conscious of this, historians over recent decades have paid careful attention to the nature of science in the era, rather than retroject the category by reference to current understandings of the term. In part, then, the links between science and exegesis which are displayed as so pervasive in these essays are ones that emerge from a changing perception of the terrain and extent of science, of how the era conceived of its study of nature. The content of natural philosophy in the early modern period had a much broader meaning than it does today and encompassed a range of concerns no longer deemed 'scientific' (notably alchemy and hermetic thought), the exclusion of which, however, does a disservice to the intellectual landscape.

While Catholic and Protestant responses to astronomy have received a great deal of attention in the history of science, the subject of 'inferior astronomy', by which is meant alchemy, and its relation to exegesis has been less well studied, despite the fact that 'the branches of science least valued by modern commentators were precisely those that were cultivated by the more unorthodox Puritans'.[34] The Jesuits may have been interested in astronomy, but it is notable that their scientific treatises had a general tendency to denounce alchemy and chemical medicine as magic and diabolical. Though no admirer of the Jesuit adherence to Aristotelianism, Mersenne is another example of a Catholic whose initial response to alchemy was less than positive.[35] This neglect of the science of alchemy is all the more surprising when we consider that its foremost champion, the Swiss Catholic Philippus Theophrastus Paracelsus of Hohenheim (1493–1541), conferred upon it a new status, revolutionising its practice, redirecting it from the transmutation of metals (*chrysopoeia*) to the preparation of chemical medicines (*chymiatria*). Paracelsus rejected much of the Aristotelian epistemology, threw down the gauntlet to the 'heathenish Philosophie' of the Galenic medical tradition of the universities and called for a return to the purity of

Adamic knowledge, inducing the rebirth of the doctrine of Signatures, the hermetic art by which the virtues and powers of natural things could be read from their external marks and characters.[36]

Harrison remarks that 'the followers of Paracelsus in particular regarded the movement back to the books of scripture and nature as part of a single revival of learning which could overturn the unholy alliance of Aristotle and the Church', citing one early follower's view of Copernicus and Paracelsus as the Luther and Calvin of natural philosophy.[37] Paracelsus's voluminous alchemical and heterodox theological works influenced the scientific and religious worldviews of figures as diverse as Bacon, Boyle, Bruno and Brahe. The first chapter of Genesis was a source for much theoretical speculation not just for the astronomers in their observatories, but also for the chemists who likewise worked with a 'coelum' or heaven in their laboratories. Peter Forshaw's essay investigates Paracelsian interpretations of the moment of Creation, particularly in the writings of the Lutheran alchemist Heinrich Khunrath (1560–1605), one of the first wave of a predominantly Protestant revival of Paracelsianism in the late sixteenth century, who resembles Bruno in his application of an expanded set of interpretative senses, but is distinctly literal in his alchemical exegesis of Genesis. The essay compares theories of primal matter in theological and alchemical writings and provides examples of critical responses of orthodox representatives from both sides of the confessional divide, highlighting the problematic nature of the relation between scriptural truth and literal science.

Astrology is another subject most historians of science used to fastidiously consign to the dustbin of history as a benighted pseudo-science, marginalising its significance in the works of any canonical figure. Here Håkan Håkansson demonstrates through his analysis of the Danish aristocrat Tycho Brahe (1546–1601), famous for establishing the astronomical castle of Uraniborg on the Isle of Hven, the extent to which natural philosophy could co-exist with a thoroughbred prophetic biblicism linked with the stars. Brahe is an embodiment of the move to empiricism and precision of observation and so influential were his theories that after Clavius's death in 1612 the Collegio Romano made the Lutheran Dane's geoheliocentric cosmology their own. His observation of the celestial world was not, however, limited to the empirical and scientific uses to which it might be put; but was predicated on its value in interpreting world (by which is meant eternal) history. This material manifests itself in highly sectarian ways – the antichrist was a key preoccupation of chronologies and apocalyptic readings of the Bible – and the essay establishes the extent to which such reading of the Bible

in prophetic mode would quite naturally call upon astronomical data, to forward ideas that were increasingly political. One of Brahe's student assistants at Uraniborg, it should be added, Kørt Aslaksson (1564–1624), is another example of a scientist who attempted to create a Mosaic physics compatible with Genesis in his *Physica et ethica Mosaica* (1613).[38]

A great number of people who were by no means professional theologians engaged extensively with the Bible in this era and an equally large number of writers treated natural philosophy without being 'scientists' in any sense of the term. The concluding essays consciously focus on such figures, who attempt to forge within their writing an accommodation between natural philosophy and the scriptures. Such a cultural amalgam resists division not only between science and religion, but equally between science and humanist approaches to nature.[39] Karen Edwards shows how natural history had recourse to complex exegetical strategies, themselves tied to political meanings, and the manner in which the understanding of animals, far from being a disinterested science, was tied to a set of partisan cultural imperatives. Exploring Thomas Browne's appraisal of the biblical locust and the early modern search for its contemporary English equivalent, she finds such apparently 'scientific' questions of identification becoming embroiled in poetic and political identities within royalist verse and republican polemic. Browne's work epitomises the generic fluidity in the period; at times scientific, deeply indebted to humanist modes of thinking and having frequent recourse to exegetical material, he defies categorisation and his intricate disciplinary tapestries are explored further in Kevin Killeen's essay on the roots and uses of seminal theory.

Various critics have, it might be noted, suggested the importance of exegesis, and how it functioned as an analogy in the approach to other subjects. Stephen Zwicker, for example, notes the extent to which early modern thought emerged from 'the deeply felt habits of exegesis … and their steady presence far beyond the reading of scripture'.[40] While Zwicker focuses on political uses of exegesis, James Bono suggests a similar interaction in relation to scientific practice: 'Knowledge of the Book of Nature was … embedded in linguistic mediations. Hence, the same techniques used to read God's Book of Scriptures could be, and were, transferred to reading the other Book, nature.'[41] These are important corrections to the somewhat ingrained historiographical practice of treating scriptural exegesis as a fundamentally retrogressive impediment to modernity. The transfer of methodologies between 'reading the scriptures' and 'reading the world', however, is not a loose analogy, but designates, rather, an almost technical procedure, and the

essays in this collection illustrate *how* such a transfer was achieved, in what sense (or senses) reading the Bible might be a model for reading the world.

Bono goes on to contend that the link is constituted largely in the presumption of what might be called an Adamic linguistics, the divine nature of things which early modern natural philosophy dreamed it could recover, emphasising the textual nature of seventeenth-century science: 'Exegesis … prescribed a hermeneutics of scientific practice that focused upon the interpretation of language and texts as bearers of a lost, but recoverable, Adamic and divine understanding of nature and things.'[42] The knowledge lost through the disobedience of Adam and Eve was a motif to which scientists repeatedly turned, rhetorically, seeing natural philosophy as a godly restorative for those attributes lost in the fall, leading Paracelsus, for example, to write in *De Caducis* that 'He who created man, the same also created science … When Adam was expelled from Paradise, God created for him the Light of Nature'.[43] The rift between the Edenic ideal and the early modern reality of humanity was deep, ranging from the shrunken limits of perception to the inadequacies of language. Introducing his account of how natural philosophy could redeem the puny human faculties, the Protestant philosopher and clergyman Joseph Glanville (1636–1680) notes, within the context of allegorical and literal interpretation of Genesis, that *Adam* needed no Spectacles. The acuteness of his natural Opticks (if conjecture may have credit) shew'd him much of the Coelestial magnificence and bravery without a *Galilaeo*'s tube', going on to suggest that advances in telescopic technology might recuperate the loss.[44] Bishop John Wilkins (1614–1672), first secretary of the Royal Society, sees in the language projects of the era and the search for a universal character a mode of circumventing the curse of Babel.[45] Fallenness runs deep in the motivation behind and the aspirations of early modern natural philosophy. Much of the development of scientific and commercial technology – mining, ship-building, navigation and an array of emergent industries – acknowledges at least a sense that they are contributing to the restoration of faculties and technologies lost in the Fall and the Flood. Perhaps more surprising, however, is the extent to which technology turns up as a subject of exegetical consideration. Jonathan Sawday's essay traces a lengthy interpretative tradition that reads the building of the Tower of Babel not only within its post-lapsarian linguistic valences – as a monument to vanity – but also as an optimistic moment of communal technology, 'perversely commendable' and a 'celebration of human ingenuity'. Such an approach, seeing

Babel as a story of scientific optimism, is testimony to the variety and flexibility to be found within the many under-explored exegetical traditions of the era.

A note on terminology may be justified. As John Brooke argues, when students of nature called themselves 'natural philosophers', they were locating themselves within intellectual traditions in which more than immediate scientific technicalities were discussed.[46] Modern discussions of the relationship between 'science' and 'religion' can run the risk of creating separate artificial categories, for it could be argued that where science and theology sought to explain the same natural phenomena they were both engaged in the joint endeavour of 'natural philosophy' – hence our preference for a focus on exegesis and science. We have worked with a broad definition of 'science', as both a body of theories and their application in technology, to permit consideration of the great variety of beliefs and practices involved in the investigation of nature.[47] This introduction and the essays in the book move freely between the terms 'science' and 'natural philosophy', while acknowledging the problematic nature and potential anachronism in using 'science' and its cognates. Likewise debates on the currency of 'Renaissance', 'Reformation' and 'early modern' as markers of periodisation are elided. While we have preferred 'early modern' within the editors' introduction, essays use all three terms which can, without undue confusion, be seen as covering, unless made otherwise clear, the sixteenth and seventeenth centuries. Without having chosen a definite *terminus ad quem*, we have considered Newton as too late for our purposes, though he too produced an exegesis of the Book of Daniel at the same time as he wrote the *Principia*, his model of the clockwork cosmos.

Notes

1. Andrew Dickson White, *A History of the Warfare of Science with Theology in Christendom*, 2 vols. (New York: D. Appleton and Company, 1896), vol. 1, p. 142. William Draper, *The History of the Conflict between Religion and Science* (London: Henry S. King & Co., 1875; reprint Farnborough, Hants: Gregg International Publishers, 1970), p. 171.
2. Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago, IL: University of Chicago Press, 1970). Among the works dealing with this subject in more nuanced terms are Harold Nebelsick, *The Renaissance, the Reformation and the Rise of Science* (Edinburgh: T & T Clark, 1992); Eugene Klaaren, *Religious Origins of Modern Science* (Grand Rapids, MI: Eerdmans Publishing, 1977); Alister E. McGrath, *The Foundations of Dialogue in Science and Religion* (Oxford: Blackwell, 1988). Useful collections of essays are David C. Lindberg and Ronald L. Numbers, *God and Nature: Historical Essays on the Encounter*

between Christianity and Science (Berkeley: University of California Press, 1986) and David C. Lindberg and Robert S. Westman, *Reappraisals of the Scientific Revolution* (Cambridge: Cambridge University Press, 1990).

3. Robert Boyle, *The Excellency of Theology, Compar'd with Natural Philosophy, (as both are Objects of Men's Study)* (1674) in *The Work of Robert Boyle*, ed. Michael Hunter and Edward B. Davis, 14 vols. (London: Pickering and Chatto, 2000), vol. 8, p. 32. See also Jan W. Wojcik, *Robert Boyle and the Limits of Reason* (Cambridge: Cambridge University Press, 1997); Michael Hunter, *Scrupulosity and Science* (Woodbridge: Boydell Press, 2000); David L. Woodall, 'The Relationship between Science and Scripture in the Thought of Robert Boyle', *Perspectives on Science and Christian Faith* 49 (March, 1997), 32.
4. Peter Harrison, 'Curiosity, Forbidden Knowledge, and the Reformation of Natural Philosophy in Early Modern England', *Isis* 92:2 (June, 2001), 265–290, at 278; Lambert Daneau, *The Wonderfull Woorkmanship of the World, wherin is conteined an excellent discourse of Christian naturall philosophie concernyng the fourme, knowledge and use of all things created; specially gathered out of the fountaines of holy scripture*, trans. Thomas Twyne (London, 1578), F. 7^{v}.
5. Edward Grant, 'Science and Theology in the Middle Ages', in Lindberg and Numbers, *God and Nature*, pp. 49–75, at p. 66.
6. Introduction, in Lindberg and Numbers, *God and Nature*, p. 11.
7. Thomas Campanella, *A Defense of Galileo, the Mathematician from Florence*. Translated with an introduction and notes by R. J. Blackwell (Notre Dame, IN: University of Notre Dame Press, 1994), pp. 54, 68–69.
8. George Hughes, *An Analytical Exposition of the Whole first Book of Moses called Genesis* (London, 1672), 'To the reader', sig. A5^{r}.
9. Jole Shackelford, *A Philosophical Path for Paracelsian Medicine: The Ideas, Intellectual Context, and Influence of Petrus Severinus: 1540–1602* (Copenhagen: Museum Tusculanum Press, 2004), p. 172.
10. Thomas Williams, 'Biblical Interpretation', in Eleonore Stump and Norman Kretzmann (eds), *The Cambridge Companion to Augustine* (Cambridge: Cambridge University Press, 2001), p. 60.
11. Augustine, *De Genesi ad litteram*, trans. as *The Literal Meaning of Genesis*, ed. John Hammond Taylor, 2 vols. (New York: Newman Press, 1982), 1.21.41.
12. See Amos Funkenstein, *Theology and the Scientific Imagination from the Middle Ages to the Seventeenth Century* (Princeton, NJ: Princeton University Press, 1986), pp. 3–9, 299–326.
13. See John Hedley Brooke, *Science and Religion: Some Historical Perspectives* (Cambridge: Cambridge University Press, 1991; reprint 1993), pp. 192–225, both on the historiographical traditions of conflict and harmonious models. On critical traditions in the history of science, see H. Floris Cohen, *The Scientific Revolution: A Historiographical Inquiry* (Chicago, IL: University of Chicago Press, 1994).
14. Useful works include Donald McKim (ed.), *Historical Handbook of Major Biblical Interpreters* (Leicester: Intervarsity Press, 1998); Hans Frei, *The Eclipse of Biblical Narrative* (New Haven, CT: Yale University Press, 1974); Alan Hauser and Duane F. Watson, *A History of Biblical Interpretation*, 5 vols. forthcoming (Grand Rapids, MI: Eerdmans Publishing, 2003–); Richard A. Muller and John L. Thompson (eds), *Biblical Interpretation in the Era of the Reformation* (Grand Rapids, MI: Eerdmans Publishing Company, 1996);

David C. Steinmetz (ed.), *The Interpretation of the Bible in the Sixteenth Century* (Durham, NC: Duke University Press, 1995); Richard Griffiths (ed.), *The Bible in the Renaissance: Essays on Biblical Commentary in the Fifteenth and Sixteenth Centuries* (Aldershot: Ashgate, 2001).

15. Peter Harrison, *The Bible, Protestantism and the Rise of Natural Science* (Cambridge, Cambridge University Press, 1998), p. 4.
16. Henri de Lubac, *Medieval Exegesis: The Four Senses of Scripture*, trans. Mark Sebanc (vol. 1) and E. M. Macierowski (vol. 2) (Grand Rapids, MI: Eerdmans Publishing, 1998, 2000). There are a number of variants on this interpretative scheme.
17. K. E. Greene-McCreight, *Ad Litteram: How Augustine, Calvin, and Barth Read the "Plain Sense" of Genesis 1–3* (New York: Peter Lang, 1999), p. 97: 'verum sensum scripturae, qui germanus est et simplex.'
18. Augustine, *De Doctrina Christiana,* trans. R. P. H. Green (Oxford, Oxford University Press, 1997), p. 64.
19. Boyle, *Excellency*, p. 31.
20. Robert Boyle, *Of the Usefulness of Natural Philosophy*, in *The Works of the Honourable Robert Boyle*, 5 vols. (London, 1744), vol. 1, p. 432.
21. Michael T. Walton, 'Robert Boyle, "The Sceptical Chymist," and Hebrew', in Gerhild Scholz Williams and Charles D. Gunnoe, Jr. (eds), *Paracelsian Moments: Science, Medicine, & Astrology in Early Modern Europe* (Kirksville, MO: Truman State University Press, 2002), pp. 187–205, at p. 203, citing Boyle's *Excellency of Theology*.
22. Studies of Boyle himself have, it should be noted, shown themselves fully aware of the complexities of interaction between his theology and natural philosophy; see, for example, Jan W. Wojcik, *Robert Boyle and Limits of Reason* (Cambridge: Cambridge University Press, 1997) and Michael Hunter, *Robert Boyle (1627–91) Scrupulosity and Science* (Woodbridge: Boydell Press, 2000).
23. Kenneth J. Howell, *God's Two Books: Copernican Cosmology and Biblical Interpretation in Early Modern Science* (Notre Dame, IN, University of Notre Dame Press, 2002), p. 11.
24. Galilei Galileo, 'Letter to the grand Duchess Christina concerning the Use of Biblical Quotations in Matters of Science' (1615), in Stillman Drake (ed. and trans.), *Discoveries and Opinions of Galileo* (New York: Anchor, 1957), pp. 175–216, at 186 n. 8: 'That the intention of the Holy Ghost is to teach us how one goes to heaven, not how heaven goes.' A marginal note by Galileo assigns this epigram to Cardinal Baronius (1538–1607).
25. See, for example, Ernan McMullin, 'Galileo on Science and Scripture', in Peter Machamer (ed.), *The Cambridge Companion to Galileo* (Cambridge: Cambridge University Press, 1998); William E. Carroll, 'Galileo, Science and the Bible', *Acta Philosophica* 6 (1997), 5–33; Maurice A. Finnocchiaro (ed.), *The Galileo Affair: A Documentary History* (Berkeley: University of California Press, 1989); Richard Blackwell, *Galileo, Bellarmine, and the Bible* (Notre Dame, IN: University of Notre Dame Press, 1991).
26. A summary, discussion and reprint of key articles on the matter is given in I. Bernard Cohen (ed.), *Puritanism and the Rise of Modern Science* (New Brunswick, NJ: Rutgers University Press, 1990). Merton's formulation is quoted on p. 15 of Cohen's introduction. The argument has been taken up and modified by, for example, Christopher Hill, *Intellectual Origins of*

the English Revolution (Oxford: Clarendon Press, 1965) and Charles Webster, *The Grand Instauration; Science, Medicine and Reform, 1626–1660* (London: Duckworth, 1975).

27. Also problematic in the idea is assessing who is 'Puritan' or, indeed who qualifies as a 'scientist'. See, for example, Theodore Rabb, 'Puritanism and the Rise of Experimental Science in England', in Charles Webster (ed.), *The Intellectual Revolution of the Seventeenth Century* (London: Routledge and Kegan Paul, 1974); John Dillenberger, *Protestant Thought and Natural Science: A Historical Interpretation* (London: Collins, 1961), p. 130.
28. On Catholic science in the era, see, for example, John W. O'Malley, Gauvin Alexander Bailey, and Steve J. Harris (eds), *The Jesuits: Cultures, Sciences, and the Arts 1540–1773*, 2 vols. (Toronto: University of Toronto Press, 1999, 2006); Mordechai Feingold (ed.), *Jesuit Science and the Republic of Letters* (Cambridge, MA: MIT Press, 2003); Mordechai Feingold (ed.), *The New Science and Jesuit Science: Seventeenth Century Perspectives* (Dordrecht: Kluwer Academic Publishers, 2002).
29. Paolo Rossi, *The Birth of Modern Science*, trans. Cynthia De Nardi Ipsen (Oxford: Blackwell, 2000), p. 108. See Paul-Henri Michel, *The Cosmology of Giordano Bruno*, trans. R. E. W. Maddison (London: Methuen, 1973); Hilary Gatti, *Giordano Bruno and Renaissance Science* (Ithaca, NY: Cornell University Press).
30. See E. Rothacker, *Das 'Buch der Natur': Materialien und Grundsatzliches zur Metapherngeschichte* (Bonn: Bouvier, 1979). The trope was by no means unique to the period. On its medieval provenance, see Ernst Robert Curtius, *European Literature and the Latin Middle Ages*, trans. Willard R. Trask (London: Routledge and Kegan Paul, 1953), ch. 16, 'The Book as Symbol'.
31. Thomas Browne, *Religio Medici* in *works*, ed. Geoffrey Keynes, 4 vols. (London: Faber, 1964), vol. 1, pp. 24–25, 1.16.
32. Quoted and translated in John Headley, *Tommaso Campanella and the Transformation of the World* (Princeton, NJ: Princeton University Press, 1997), p. 169.
33. See Stephen A. McKnight (ed.), *Science, Pseudo-Science, and Utopianism in Early Modern Thought* (Columbia: University of Missouri Press, 1992); Margaret J. Osler (ed.), *Rethinking the Scientific Revolution* (Cambridge: Cambridge University Press, 2000).
34. Charles Webster, 'Puritanism, Separatism, and Science', in Lindberg and Numbers, *God and Nature*, p. 193.
35. Armand Beaulieu, 'L'attitude nuancée de Mersenne envers la Chymie', in Jean-Claude Margolin and Sylvain Matton (eds), *Alchimie et Philosophie à la Renaissance* (Paris: Vrin, 1993), pp. 395–403.
36. See Massimo Luigi Bianchi, *Signatura Rerum: Segni, Magia e conoscenza da Paracelso a Leibniz* (Roma: Edizioni dell' Ateneo, 1987).
37. Harrison, *The Bible, Protestantism and the Rise of Natural Science*, pp. 105–106.
38. Shackelford, *A Philosophical Path for Paracelsian Medicine*, p. 320. See Ann Blair, 'Mosaic Physics and the Search for a Pious Natural Philosophy in the Late Renaissance', *Isis* 91 (2000), 32–58.
39. On exegesis and science within humanist thought, see Kevin Killeen, *Searching the Scriptures and Reading the Natural World: Biblical Exegesis and Interpretative Strategies in Early Modern Literary Culture* (Ph.D. thesis, University of London, 2004).

40. Stephen N. Zwicker, *Lines of Authority: Politics and English Literary Culture, 1649–1689* (Ithaca, NY: Cornell University Press, 1993), p. 4. Zwicker's emphasis is on typology and political allegory.
41. James Bono, *The Word of God and the Languages of Man: Interpreting Nature in Early Modern Science and Medicine, Vol. 1: Ficino to Descartes* (Madison: University of Wisconsin Press, 1995), p. 12.
42. Bono, *Word of God*, p. 81.
43. Paracelsus, *De Caducis*, in Arthur Edward Waite, *The Hermetic and Alchemical Writings of Paracelsus, The Great*, 2 vols. (Chicago, IL: de Laurence, Scott & Co., 1910), vol. 1, 48 n.
44. Joseph Glanvill, *The vanity of dogmatizing, or, Confidence in opinions manifested in a discourse of the shortness and uncertainty of our knowledge, and its causes* (London, 1661), p. 5.
45. John Wilkins, *An Essay Towards a Real Character and a Philosophical Language* (London, 1668). See Rhodri Lewis, *Language, Mind and Nature: Artificial Languages in England, Bacon to Locke* (Cambridge: Cambridge University Press, 2007), forthcoming.
46. Brooke, *Science and Religion, Some Historical Perspectives*, pp. 7–8.
47. For a helpful discussion of 'science' and 'natural philosophy', see David C. Lindberg, *The Beginnings of Western Science: The European Scientific Tradition in Philosophical, Religious, and Institutional Context, 600 B.C. to A.D. 1450* (Chicago, IL: University of Chicago Press, 1992), pp. 1–4.