The Boyle Lecture 2010

**The Legacy of Robert Boyle: Then and Now**

John Hedley Brooke

Formerly Andreas Idreos Professor of Science and Religion

University of Oxford

Given at the Guild Church of St Mary Aldermary, London

Tuesday 16th February 2010

With a Response by Geoffrey Cantor

Formerly Professor of the History of Science

University of Leeds

The frontpiece shows a statue of Robert Boyle as a young boy on the tomb commissioned by his father in St Patrick's Cathedral, Dublin, to commemorate Boyle's mother, Catherine, who died in 1630. The tomb was completed around 1632.

Contents

 Biographical Notes 5

 The Boyle Lecture 2010

**The Legacy of Robert Boyle: Then and Now**

 John Hedley Brooke

Formerly Andreas Idreos Professor of Science and Religion

 University of Oxford 7

 Response

 Geoffrey Cantor

Formerly Professor of the History of Science

University of Leeds 21

 Arrangements for next year’s Boyle Lecture (2011)

 Biography of Professor Jürgen Moltmann 27

**Biographical Notes**

|  |  |
| --- | --- |
| **Lecturer --- John Hedley Brooke**John Hedley Brooke was educated at Cambridge University, obtaining a first class degree in the natural sciences (1965) and a doctorate for work on the history of chemistry (1969). For 30 years he taught at Lancaster University, becoming a member of the International Academy of the History of Science in 1993. In 1995, with Professor Geoffrey Cantor, he gave the Gifford Lectures at Glasgow University. From 1999 to 2006, he was the first Andreas Idreos Professor of Science & Religion at Oxford University, Director of the Ian Ramsey Centre and Fellow of Harris Manchester College. Following retirement, he has spent time as a 'Distinguished Fellow' at the Institute of Advanced Study, University of Durham (2007). He has lectured worldwide on science & religion and in November 2001 gave the 'Distinguished Lecture' of the History of Science Society. From 2000 to 2003 he directed the European Science Foundation’s Network on 'Science and Human Values'.A former Editor of the British Journal for the History of Science, he has been President of the British Society for the History of Science, President of the Historical Section of the British Association for the Advancement of Science, and President of the UK Forum for Science & Religion. He is currently President of the International Society for Science and Religion. Among his books are *Science and Religion: Some Historical Perspectives* (1991), which won the Watson Davis Prize of the History of Science Society and a Templeton prize for outstanding books on science & religion; *Thinking About Matter* (1995); and (with Geoffrey Cantor) *Reconstructing Nature: The Engagement of Science & Religion* (1998). He has also contributed to both *The Cambridge Companion to Darwin* (2003) and *The Cambridge Companion to The Origin of Species* (2008). |  |
|   |   |
| **Responder --- Geoffrey Cantor**Geoffrey Cantor is professor of the History of Science at the University of Leeds. With a background in physics he moved first into the history of physics, with a focus on optics. His interest in the issues of science and religion first gelled in his research on Michael Faraday and Faraday’s involvement with the Sandemanian church. His research in this area has subsequently developed in several directions including the 1995-96 Gifford Lectures at Glasgow (with John Brooke) which explored the uses of history in our understanding science-religion interrelations. He has also researched the attitudes towards science of small religious communities – specifically the Quakers and Anglo-Jewish communities – in 18th- and 19th-century Britain. His other main research focus is the SciPer project, which examines the role of science in the general periodical press of the 19th century.His main publications in the area of science and religion are: *Optics after Newton. Theories of Light in Britain and Ireland*, 1704-1840 (1983); *Michael Faraday: Scientist and Sandemanian - A Study of Science and Religion in the Nineteenth Century*(1991) and (with John Hedley Brooke) *Reconstructing Nature: The Engagement of Science and Religion* (1998). *Quakers, Jews, and Science: Religious Responses to Modernity and the Sciences in Britain* 1650-1900 (2005).  |  |

**The Legacy of Robert Boyle: Then and Now**

**John Hedley Brooke**

Late in the seventeenth century, in the church of St. Mary-le-Bow, a sermon was preached on the folly of atheism. It was an unusual lecture because the congregation heard how the denial of a God was at odds with the latest science. The orator was a fine scholar and sure of his facts. The design of the universe had to be ascribed to divine wisdom. Who was this confident apologist? His initials were **RB.** His name: ….Richard Bentley.

A classics scholar, Bentley gave the first of a long, and distinguished series of what came to be known as the Boyle lectures. They owe their name to the fact that one of England’s greatest scientists provided the legacy that made them possible. In his will, Robert Boyle bequeathed the sum of £50 per annum “for ever, or at least for a considerable number of years”. The lecturers would have as their brief: to prove the Christian religion “against notorious Infidels, viz. Atheists, Theists, Pagans, Jews, and Mahometans.” And as a rider, to which we shall return, he added that they were not to descend to “any controversies … among Christians themselves.” Boyle’s philanthropy was not just a post-mortem gesture. In a life dedicated to conciliation between science and Christianity, he had financed translations of the New Testament into exotic languages and funded numerous foreign missions. So who was this figure, without whom we would not be gathered here?

**Who was Boyle?**

Young Robert had been born into one of the most elevated aristocratic families in England. He was the youngest son of Richard Boyle, Earl of Cork and Lord High Treasurer of Ireland before the Civil War. Robert may have been surprised to find that he had been born at all. He was the fourteenth of fifteen children. His education included three years at Eton and was extended by foreign travel in the company of a private tutor. He would learn Italian in order to read the works of Galileo and it was while abroad that he read meaning into a violent thunderstorm. He saw, as it were in a flash, that he was ill prepared for the Day of Judgment. His religious conversion did not kill his curiosity and it has been said of his time in Italy and France that he was repelled, but also fascinated, by Catholic religious practices that he had been taught to see as superstitious. He never lost interest in stories relayed to him about the paranormal and the supernatural.

A reversal in the family fortune as a consequence of the Civil War and Irish Rebellion was itself gradually reversed. From 1645 to 1655 Boyle lived on the family estate at Stalbridge in Dorset. As Michael Hunter has pointed out, there were features of aristocratic society that, to the studious, were less than congenial. In Boyle’s own words, how easy it was to “squander away a whole afternoone in tatling of this Ladys Face & tother Lady’s Clothes; of this Lords being Drunke & that Lord’s Clap; in telling how this Gentleman’s horse outrun that other’s Mare” (Hunter 1999: 261). If Boyle had already had his religious conversion, his conversion to science came during his Stalbridge years. By 1649 he had set up a chemical laboratory where he subjected chemical substances to analysis by fire. A fume-filled chemistry lab is not everyone’s vision of heaven, but for Boyle it almost was. To his sister he wrote: “*Vulcan* has so transported and bewitched me, that I fancy my laboratory a kind of *Elysium*” (Hunter 1999: 262). In 1655 he moved to Oxford where he was welcomed in the scientific circle that gathered around John Wilkins, Warden of Wadham College.

Wilkins played a leading role in the establishment of the Royal Society, which is celebrating its 350th anniversary this year. Boyle played *his* part, attending its meetings, serving on the Council, proposing new members and occasionally donating apparatus. This was necessary because, in its early years, it was a Society with a Royal charter but without royal cash. In 1668 he moved from Oxford to London where he lived with his sister Katherine for the rest of his life, never marrying.

Those who have studied Boyle in depth invariably refer to the strength of his religious convictions. Why, despite encouragement, did he decline the Anglican priesthood? He had a thoughtful answer to that question. His defence of Christianity and of its harmony with science would be more effective if he remained a layman. To write as a clergyman would have risked the cynical retort that “he would say that wouldn’t he?” Boyle was content, in his own words, to be a “priest in the temple of nature”.

In the world of science Boyle enjoys the reputation of a progressive, as the proponent of a mechanical philosophy of nature that challenged Aristotelian accounts of why substances have the properties they do. The title of his book *The Sceptical Chymist* has suggested to the unwary that he must have cleansed chemistry of its alchemical pretensions. But he is best known for the discovery of a law with his name on it – the inverse relationship between the pressure and volume of an ideal gas at constant temperature.

There are, however, problems with each of these pictures. Boyle’s law was never formulated as a law by Boyle. He simply tabulated pressure readings and the volume readings with which they were correlated. He was much less interested in *ideal* gases than in real ones. He did explain chemical reactions mechanically by supposing that hierarchies of particles or “corpuscles” of matter were broken down and reassembled in different ways. Why is an acid an acid? The Aristotelian might say: “because it has the form of acidity”. Boyle was not alone among seventeenth-century chemists in wanting more than this. It might rather be that the constituent particles of an acid were in particular states of motion or had sharp edges that would account for their potency. Swill an acid around your mouth and you can feel the little daggers in your tongue – not an experiment I particularly recommend! But it is easy to exaggerate the scope Boyle gave to his mechanical explanations. His universe contained many non-material items, of which the human mind was a primary example. He tells us that he *was* long distrustful of stories about the philosopher’s stone; but increasingly he became what Larry Principe describes as an “aspiring adept” (Principe 1998). His scepticism in *The Sceptical Chymist* was not directed against the possibility of metallic transmutations but against prevailing methods of fire analysis that purported to reveal the true elements of bodies.

There *were* chemical adepts who abandoned their alchemical dreams. Boyle kept a more open mind. He even believed that if the philosopher’s stone could be found it might have the property of attracting spirits, hopefully angelic rather than demonic. And that would meet another of his lifelong concerns: the refutation of atheism. He worried about the probity of experiments that might compromise his piety; but, as he once wrote, it required only one properly authenticated relation of a supernatural phenomenon to defeat the atheist. When one of the characters in a dialogue composed by Boyle suggests that “Tis not likely that air and fluid parts of the world should be destitute of spirits” and adds that “Tis not likely that there should be so few spirits or so few orders of them as is commonly presumed”, we are taken back to a world we have lost (Principe 1998: 310). And if the past to which Boyle belonged is such a foreign country, is there any point in resurrecting him? Is it even meaningful to ask whether he left an intellectual legacy that might be of any relevance today?

**Deterrents to the resurrection of Boyle**

Discontinuities between Boyle’s time and ours are of course legion. The world we have lost was one in which scientific truths might still be authenticated in Scripture. Boyle’s contemporary Henry More declared Moses to have been the first atomist. There are echoes of such an outlook today in some Muslim attempts to authenticate the Qur’an from its supposedly scientific prescience. But this is not a strategy approved by discerning Muslim scientists.

Boyle’s world was a world only just dislodged from the centre of the universe, John Wilkins having championed the Copernican system in England. It was a world that by our standards was still young, no more than a few thousand years old. Humans had been on the Earth from the beginning and references to a created world were to one in which God’s creatures had been preserved in their original form. The spectre of mass extinctions was far in the future and public debates over Darwinian evolution still some two hundred years hence. And because Darwin’s science was to threaten the design argument in its seventeenth-century formulations, we cannot ignore Richard Dawkins’ well-known objection that *any* philosophy of nature constructed before Darwin will be worthless.

Boyle was a creature of his time and we saw this in the chauvinism inscribed in his will. You will have noticed that Muslims and Jews are aligned with atheists, and even plain theists, as opponents. It is not my aim to abstract a sanitised Boyle from the scientific and religious worlds he occupied. His assumption, for example, that matter is entirely passive and amenable to immaterial influences contrasts with modern images of active, self-organising matter. His clockwork universe, elaborated in its more familiar Newtonian form, has not survived the revolutions in twentieth- century physics. But there are certain parallels with our own time that bear investigation:

We often hear today about a “new atheism”, for which Dawkins is the best-known proselyte. There was a new atheism in Boyle’s day, typified by a renaissance of the atomic philosophy of Epicurus and Lucretius. We face a threat today from the zeal of religious fundamentalists. Boyle had to contend with their equivalents in mid-seventeenth-century England - Protestant zealots with their hot lines to God. To Boyle’s annoyance, they were giving the false impression that Christianity and philosophy were incompatible. Despite the far higher profile that a culture of science and technology enjoys today, we often hear of a public suspicion of scientific authority. It is a suspicion not so dissimilar to that faced by Boyle and his contemporaries who had to make the foundational case for the utility of science.

There are other parallels. Standard neo-Darwinian mechanisms for evolution do constitute a difficulty for those seeking a providential God having recognisable purposes in the world. But ends, goals, final causes, purposes in nature were already under threat when Boyle took up his pen. And this from two different directions: from the Epicurean vision that the world is the chance product of atomic collisions; but also from the philosophy of Descartes. I am always reminded here of the student who revealed in his essay that Descartes was a Cartesian! The challenge came from Descartes’s insistence, ostensibly on theological grounds, that it is presumptuous to imagine we can discern God’s purposes in nature. We shall see later how Boyle rose to this dual challenge. He deserves a hearing because he illustrates a point that the modern world sometimes forgets – that it was possible to find in Christian theology resources to promote, to legitimate and in some instances motivate an intensive study of nature. If Boyle contributed to an *enduring* scientific movement then there is a sense in which his legacy has been enduring. Michael Hunter, who has written so authoritatively on Boyle, declares that it is “not an exaggeration to describe Boyle as the founder of experimental science in the modern sense” (1999: 263). And if Hunter is right, as I believe he is, in seeing “great profundity” in Boyle’s reflections on the relationship of science to religion, then we should not be stalled by deterrents.

# Boyle and the promotion of experimental science

It is sometimes said that without Christianity there would have been no modern science. A doctrine of Creation provided the grounds for believing that nature was ordered and intelligible and that the human mind had a God-given capacity to understand it. The more we have learnt of scientific practices in other cultures, especially the achievements of the medieval Islamic world, the more difficult it is to argue for an exclusively Christian impetus. But there remains a question, recently addressed by Peter Harrison and Stephen Gaukroger: why was it only in the West that an *enduring* scientific culture was established? Other cultures had their science but the pattern was “boom and bust” (Gaukroger 2006). By contrast, the scientific movement in seventeenth-century Europe gained a momentum that proved unstoppable. The reasons are many and complex. But they include the fact that within the Judeo-Christian tradition there were resources for legitimating a humble, experimental science. Francis Bacon had tapped some of these earlier in the seventeenth century. In Boyle we have a window on how Christianity and scientific virtuosity were fused together.

Like Bacon before him, Boyle spoke of God as the author of two books, the Bible and the book of His works. As there was a duty to study the Scriptures, so there was a duty to study the book of nature. Since the two books had the same author they could not conflict. Knowledge gleaned from nature might assist the interpretation of Scripture, as Galileo had argued. Boyle underlined the same point: “God has made some knowledge of his created book, both conducive to belief, and necessary to the understanding of his written one” (Harrison 1998: 136).

Today we take experimental methods in science for granted. In Boyle’s day they were problematic. One could argue that it was less arrogant to investigate the world empirically than to take one’s authority from Aristotle or to philosophise in an armchair. But there were at least three problems. If someone came along claiming they had performed an experiment that exploded a prevailing view, why should you believe him, why should you believe his experiment had been well designed and properly conducted, and why should you believe his interpretation of the data? It helped, of course, if the experimenter were a trustworthy gentleman, an advantage that a refined Robert Boyle certainly had. This means that there was a moral and social dimension to the corroboration of scientific knowledge. Credible witnesses to an experiment were not always available, but when they were they were a godsend. It was a complicated matter because to automatically reject reports of strange natural phenomena ran the risk of encouraging a mindset in which witnesses to the biblical miracles might be impugned.

When Boyle commended an experimental philosophy, it was not a philosophy based simply on observation. As Bacon had recognised, one had to intervene in nature to extract her secrets. Boyle’s experiments in chemistry show how he helped to consolidate the Baconian programme. For example, through an elaborate sequence of operations, he not only decomposed saltpetre but also managed to recompose it. So what? - you might think. In fact his experiment was a significant moment in the long history of differentiating nature from art. It was conventionally supposed that a product found in nature owed its integrity to a homogeneous “form” that could not be replicated artificially. In Boyle’s mechanical chemistry it could be. And I use the word ‘mechanical’ deliberately because there was a far wider sense in which the distinction between nature and art was breaking down in seventeenth-century science. When the universe was compared to a machine there was a sense in which nature became an artefact, the work of a divine craftsman. All things are artificial wrote one contemporary because “nature itself is nothing but the art of God” (Brooke and Cantor 1998: 323).

Now we can perhaps begin to see how Boyle could present himself as a Christian virtuoso. One of his favourite moves was to compare the universe with the cathedral clock in Strasbourg. The analogy might have its problems. How could God act in a universe that ran like clockwork? But, for Boyle, the analogy played a powerful heuristic role. It created the space for both science and religion. The task of the scientist was to investigate the machinery of nature, the cogs, the wheels and the springs. He would speak of the “spring” of the air and even suggested it might be made of microscopic springs that accounted for its greater pressure when compressed. But the clockwork analogies also left room for religious belief because clocks, after all, are made for a purpose. Machines do not spring into existence by themselves. And it was not merely that room was left for religious belief. The exquisite machinery to be found in creation positively required it. The construction of the human eye, for example, was a work of such delicate craftsmanship that it testified to divine wisdom.

The connections that Boyle made between his Christianity and his science are manifold and intimate. As he set the parameters for a science-based natural theology, he argued that it was the accomplished natural philosopher who was in the best position to appreciate God’s workmanship. One had to pry into the recesses of nature to fully appreciate divine wisdom and that in turn required a competence in anatomy, optics, mechanics and chemistry (Goodman 1973: 126). Chemistry in particular helped to realise the Baconian dream. It offered the prospect of improving the world and of restoring a dominion over nature lost at the Fall. There was the seductive promise of a better world if scientific knowledge were applied to the relief of man’s estate. There is a sense in which Boyle personifies the application of chemistry to medicine. He had his own chemical cordials, which he trusted more than any physician. Indeed it was reported that when he woke each morning he would consult his ceiling compass to see from which direction the wind was coming and then take the appropriate antidote. So, observed Roger North, if the wind were often to change direction Mr Boyle was wont to become drunk (Boas Hall 1958: 18-19).

# Boyle and the revival of natural theology

Claims are sometimes made today for a revival of natural theology. By revisiting Boyle we can see some of the reasons why arguments from nature to God have had a recurring appeal. Boyle never believed that a rational theology could be free-standing. Scripture had a crucial role in revealing a God with intentions for humanity, one of which was that we *should* have responsibility for and dominion over nature (Goodman 1973: 116-17). In Boyle there was an inter-weaving of natural and revealed theology. But, as we have just seen, one of his objectives was to sanctify the sciences against religious suspicion.

There were clearly other pressures to which Boyle responded and which have their modern equivalents. One was the threat to Christianity from internal divisions. In the late 1640s the proliferation of puritan sects was such that Boyle counted “no less than 200 several opinions on points of religion” (Rattansi 1972: 21). The problem was that dispute brought disrepute. To come to London, Boyle warned, was to come nigh to losing one’s faith. I am told this may still be the case. Boyle developed a double strategy to meet the threat. He stressed that in Christian doctrines, such as the Trinity, there were elements that were “above reason”. To dogmatise about so incomprehensible a matter as the nature of God was therefore inappropriate. But it also helped if one could restore a fundamental belief in the existence and wisdom of God. This might be accomplished through appeals to design in nature.

A quite different threat to Christianity came from the scoffers, immortalised in Restoration comedies. Let me remind you of a few titles: *The Merry Milkmaid of Islington, Love Lost in the Dark, The Politic Whore or the Conceited Cuckold*. These were encounters one might have when visiting what Boyle called this “libertine city”. In 1675 a wonderful description was given of *The Character of a Town-Gallant*. Frequenting the coffee-houses and pretending to know something of Thomas Hobbes, he would laugh at spirits and maintain that there are “no Angels but those in petticoats” (Principe 1998: 203). A practical as well as a cerebral atheism had to be addressed. Boyle resolutely wrote that only someone who had not studied nature could be an atheist. Even those of the meanest intellect, according to the great naturalist John Ray, could appreciate nature’s marvels and their testimony to divine wisdom.

In his discerning work on the history of natural theology, my respondent this evening, Geoffrey Cantor, has stressed one of the key rhetorical functions of arguments grounded in nature: to reassure those whose faith might be wavering (Brooke and Cantor 1998: 196-7). Boyle again provides a perfect illustration. He wished to provide firmer grounds for belief, to prevent the faithful from falling by the wayside and to startle the irreligious out of their stupor.

If Boyle raised the profile of natural theology it was for yet another reason. He was genuinely overawed by what science was revealing about the world. The revival of natural theology today has been inspired in part by the discovery of the anthropic coincidences and the claim that the universe appears to have been finely tuned for life (McGrath 2009). The revelation in Boyle’s day was of an entirely new world, visible only under the microscope. With a genuine sense of wonder Boyle marvelled that God had been able to pack life into the minutest mite. The eye of a fly, famously depicted by Robert Hooke in his *Micrographia*, was for Boyle a “more curious piece of workmanship than the body of the sun.” (Goodman 1973: 111). The gargantuan flea to be found in the *Micrographia* might evoke other feelings, but there were those who found a place for its bite in the economy of nature. For the poor, it provided a cheaper mode of bloodletting than an expensive visit to the doctor!

When responding to Descartes’s censure of final causes, Boyle conceded that there were inanimate objects that did not testify to divine wisdom. He also conceded that many of God’s purposes were likely to be beyond human grasp. But surely no reasonable person could deny that eyes had been made for the purpose of seeing? Other features of human anatomy, the valves in the veins for example, might once have appeared useless, but with William Harvey’s discovery of the circulation of the blood, their purpose had become clear. Immediate objections are likely to occur to us. What of the diseases of the eye? For Boyle they served to demonstrate just how delicately the healthy eye had been crafted. This was no facile response. Boyle’s own vision was impaired, and for much of his life he needed the helped of an amanuensis. What about inherently imperfect eyes, of the mole for example? Not a problem. Nature had designed moles to live underground. Boyle recognised many gradations of perfection in the eyes of other animals; but this only confirmed that his God favoured biodiversity.

The real problem of course is that in a post-Darwinian universe eyes are the product of evolution, not of contrivance. Surely we cannot pull Boyle through the Dawkins barrier? No … and yet. There is a partial resemblance between Darwin and Boyle. When Darwin defined what he meant by ‘nature’ it was this: “ the laws ordained by God to govern the universe” (Richards 2009: 61). For Boyle, too, it was a more elevated understanding of God to suppose that the material world He had created and organised was now running according to “laws” of motion. For Boyle, and most of his successors in the discourse of natural theology, you could not *have* “laws” of nature without the existence of a Lawmaker. Boyle’s God, Newton’s too for that matter, could change the laws if He wished. Boyle was astute enough to realise that to speak of “laws” at all was to use a figurative expression. Matter, after all, is not intelligent enough to know what a law is or how to obey one (Stewart 1979: 181). Nevertheless, for both Boyle and the Darwin of the 1850s, the order of nature had been ordained by a deity. Science was possible for Boyle because the laws were upheld by God’s sustaining power; for Darwin because they were fixtures in an evolving universe. But even for Darwin the laws were not bereft of purpose: they had enabled the production of the higher animals, which he once described as the greatest good we can conceive (Richards 2009).

I come now to the final section of this lecture where I want to show that there *were* insights in Boyle’s philosophy that bear scrutiny today – that there is a legacy.

**Boyle’s insights: then and now**

As restorers of purpose and design to the universe, Boyle and his successors had their detractors. The eighteenth-century deist Anthony Collins famously observed that no-one had *doubted* the existence of God until the Boyle lecturers undertook to prove it. Collins had a point (Brooke and Cantor 1998: 198). But it hardly applies to Boyle himself. His take on the issue of proof was more subtle. In a lengthy, unpublished manuscript on atheism he devoted many pages to explaining why a demonstration of God’s existence should *not* be expected (MacIintosh 2005: 70-170). For those with an open mind, a Creator God gave the best explanation of why there is a world at all and why it is ordered rather than chaotic. But inference to the best explanation was not the same as proof. Boyle’s use of language is interesting here. Knowledge of nature could illustrate divine attributes, it might “induce one to conclude” or “persuade” one of God’s existence, or to “settle” such a belief in one’s mind. But none of this amounted to a proof that would compel an atheist to believe.

Boyle was as interested in the psychology of religious belief as in its logic, and that is arguably another of his legacies. In observing the wisdom of God in nature Boyle wished his readers to be “affectively” convinced of it (Davis 1994: 162), in as much an emotional as a rational response. “Most atheists” (he did not say all) had other “affections”, even a “depraved frame of mind” that predisposed them against the proofs. And there was another blockage. Boyle wrote: “the difficulty of such speculations as belong to the contemplations of God’s attributes keeps the generality of atheists and libertines from being *qualified* for such enquiries” (MacIntosh 2005: 49).

Boyle had few doubts about his own qualifications and he remained deeply interested in what made some persons believers and others not. In one manuscript he jotted down at least nine “causes of infidelity” (MacIntosh 2005: 162-3). You do not want to hear them all; but they included a “love of independency” and a “vain affectation of applause”. So you will know what not to do after this lecture! They also included what Boyle called the “obviousness” and “intelligibility” of objections, meaning, I think, that the devil, even then, had the best sound bites. Another cause of infidelity was what Boyle described as “corrupt principles of philosophy”. And here we might begin to recognise another of his insights - that how one responds to reasoned arguments depends on where you are coming from.

In a recent study of the relations between religion and the physical sciences in the nineteenth and twentieth centuries, the American historian Fredrick Gregory has come to a conclusion that has profound implications. He writes: “throughout the last two centuries in virtually all cases of interaction between physical science and religion, the diversity of opinion displayed has stemmed from the variety of assumptions … *brought to* the issues by the participants” (Gregory 2003: 53). There can be a universal consensus on what the scientific data are. But their cultural meaning is a different matter. Scientific theories rarely, if ever, *entail* metaphysical or theological conclusions. I think Boyle deserves some credit for appreciating this. In our post-Enlightenment world we recoil at his tendency to regard immorality as a primary cause of irreligion, but he was well aware that in reactions to natural theology, everything depended on what one *brought to* the issues (Goodman 1973: 125-6).

In the first volume of his trilogy, *A Scientific Theology*, Alister McGrath reflected on the critical word ‘natural’ when contemplating the possibility of a natural theology. McGrath made the shrewd observation that the word ‘nature’ is itself imbued with so many meanings, and carries so much cultural baggage, that there is scarcely a stable platform on which a ‘natural’ theology can be erected. In certain respects Boyle would be sympathetic to that diagnosis. From ‘then’ to ‘now’ the concept of the ‘natural’ has been rendered increasingly problematic by human interference. In this the sciences have played a crucial role. Think of our bio-technologies and visions of genetic engineering to transform, enhance, even immortalise what it is to be human. Ironically, ambitions to prolong human life were part and parcel of the alchemical traditions in which Boyle took so keen an interest. More to the point, Boyle was acutely aware of ambiguity in the very word ‘nature’. In fact he was so bothered about it out that he wanted to banish the word altogether. This meant finding substitutions for all its common uses. Just to give you a taste: Instead of speaking of the ‘nature’ of a body, Boyle wanted to substitute the word ‘essence’. When ‘nature’ was used to refer to the ‘world’ or entire ‘universe’, it was no hardship to substitute those words instead. If by ‘nature’ one meant an established order of things why not simply say that? One use above all others was dissonant with his Christianity. The vulgar often spoke of nature doing this or that. In Aristotelian natural philosophy it was said that ‘nature abhors a vacuum’. But, Boyle protested, ‘nature’ was not an agent as if it were a person with intentions. It was in precisely this context where the word God should be substituted, in order to highlight the difference between the Creator and His creation. The wonderful word ‘de-deification’ has sometimes been used to express this dismissal of pseudo-gods from the world - sanitising the creation in a way that helped to make a mechanistic science possible.

The word nature has, of course, survived Boyle’s onslaught; but at least he perceived the problem and sounded the alarm.

# Conclusion

I have not been arguing that we need to revert to Boyle for a better understanding of the world. Those who invoke “intelligent design” today to pick holes in neo-Darwinian accounts of evolution are, in my view, seriously misguided. To modern ears there is much in Boyle’s moralising that will sound sanctimonious. Much of his science was eclipsed by that of Newton. But his legacy was far more substantial than the fifty pounds per annum with which he endowed the eponymous lectures. His pursuit of experimental methods had enduring consequences. And there is something in Boyle that many would say we *have* lost to our detriment – a profound sense of the wonder of nature and how to communicate that to a younger generation. Contrary to the stereotypes of modernity, Boyle bequeathed a view of the world in which there was space for both empirical science and religious faith – space for both a mechanical universe and belief in Providence. He had a special gift for finding positions that transcended opposing views, in both matter theory and theology (Davis, 1994; Wojcik 1997). He saw himself as a peacemaker, which is why the Boyle lecturers were not to descend to controversies among Christians themselves. The wish to mediate wherever possible was a personality trait of which he was deeply self-conscious. “I love to speak of persons with civility”, he wrote, “though of things with freedom”; for “a quarrelsome and injurious way of writing does very much unbecome a philosopher and a Christian” (Davis 1994: 166).

These are no mean legacies, and the example of an honourable peacemaker has never been more necessary than it is today.

### Bibliography

The writings of Boyle on which I have primarily drawn include his *Essay Containing a Requisite Digression, Concerning Those that would Exclude the Deity form Intermeddling with Matter* (1663); *The Origin of Forms and Qualities According to the Corpuscular Philosophy* (1666); *The Excellency and Grounds of the Mechanical Philosophy* (1674); *A Discourse of Things above Reason* (1681); *A Free Enquiry into the Vulgarly Received Notion of Nature* (1686); *A Disquisiton about the Final Causes of Natural Things* (1688); *The Christian Virtuoso* (1690).

They are available in *The Works of Robert Boyle* (ed. Michael Hunter and Edward B. Davis), 14 vols. London: Pickering and Chatto. 1999-2000.

Secondary sources:

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

Brooke, John Hedley (2009a). “ ‘Laws impressed on Matter by the Creator’? The *Origin* and the Question of Religion”, in Robert J. Richards and Michael Ruse (eds.), *The Cambridge Companion to the “Origin of Species”*, 256-74.

Brooke, John Hedley (2009b). “Should the Word *Nature* be Eliminated?”, in James D. Proctor (ed.), *Envisioning Nature, Science & Religion*. West Conshohocken, PA: Templeton Press, 312-36.

Brooke, John Hedley and Geoffrey Cantor (1998). *Reconstructing Nature: The Engagement of Science and Religion*. Edinburgh: T & T Clark.

Cantor, Geoffrey (1999). “Boyling Over: A Commentary”. *British Journal for the History of Science* 32, 315-24.

Davis, Edward B. (1994). “ ‘Parcere nominibus’: Boyle, Hooke and the Rhetorical Interpretation of Descartes”, in Michael Hunter (ed.), *Robert Boyle Reconsidered*. Cambridge: Cambridge University Press, 157-75.

Gaukroger, Stephen (2006). *The Emergence of a Scientific Culture*. Oxford: Oxford University Press.

Goodman, D. C. [ed.] (1973). *Science and Religious Belief 1600-1900: A Selection of Primary Sources*. John Wright in association with the Open University Press.

Gregory, Frederick (2003). “Intersections of Physical Science and Western Religion in the Nineteenth and Twentieth Centuries”, in Mary Jo Nye (ed.), *The Cambridge History of Science*, vol.5, 36-53.

Hall, Marie Boas (1958). *Robert Boyle and Seventeenth-Century Chemistry*. Cambridge: Cambridge University Press.

Harrison, Peter (1998). *The Bible, Protestantism and the Rise of Natural Science*. Cambridge: Cambridge University Press.

Harrison, Peter (2007). *The Fall of Man and the Foundations of Science*.

Cambridge: Cambridge University Press.

Hooykaas, Reijer (1997). *Robert Boyle: A Study in Science and Christian Belief, With a Foreward by John Hedley Brooke and Michael Hunter*. Lanham: University Press of America.

Hunter, Michael (1990). “Alchemy, Magic and Moralism in the Thought of Robert Boyle”, *British Journal for the History of Science* 23, 387-410.

Hunter, Michael [ed.] (1994a). *Robert Boyle Reconsidered*. Cambridge: Cambridge University Press.

Hunter, Michael [ed.] (1994b). *Robert Boyle by his Friends and Himself*. London: Pickering.

Hunter, Michael (1999). “Robert Boyle (1627-91): A suitable Case for Treatment?” *British Journal for the History of Science* 32, 261-75.

Hunter, Michael (2009). *Boyle: Between God and Science*. New Haven and London: Yale University Press.

Kenny, Christopher (1996). “Theology and Natural Philosophy in Late Seventeenth Century and Early- Eighteenth-Century Britain. PhD Dissertation, University of Leeds.

MacIntosh, J. J. (2005). *Boyle on Atheism*. Toronto: University of Toronto Press.

McGrath, Alister (2001). *A Scientific Theology: Volume 1 Nature*. Edinburgh: T & T Clark.

McGrath, Alister (2009). *A Fine-Tuned Universe*. Louisville: Westminster John Knox Press.

Osler, Margaret J. (2001). “Whose Ends? Teleology in Early Modern Natural Philosophy”, in John Hedley Brooke, Margaret Osler and Jitse M. Van der Meer (eds.), *Science in Theistic Contexts: Cognitive Dimensions*. Chicago: University of Chicago Press, 151-68.

Polkinghorne, John (1996). *Beyond Science*. Cambridge: Cambridge University Press.

Principe, Lawrence (1998). *The Aspiring Adept: Robert Boyle and his Alchemical Quest*. Princeton: Princeton University Press.

Rattansi, P. M. (1972). “The Social Interpretation of Science in the Seventeenth Century”, in Peter Mathias (ed.), *Science and Society1600-1900*. Cambridge: Cambridge University Press, 1-32.

Richards, Robert J. (2009). “Darwin’s Theory of Natural Selection and its Moral Purpose”, in Robert J. Richards and Michael Ruse (eds.), *The Cambridge Companion to the “Origin of Species”*, 256-74.

Shapin, Steven(1994). *A Social History of Truth: Civility and Science in Seventeenth-Century England*. Chicago: University of Chicago Press.

Shapin, Steven and Simon Schaffer (1985). *Leviathan and the Air-Pump: Hobbes, Boyle and the Experimental Life*. Princeton: Princeton University Press.

Stewart, M.A. [ed.] (1979). *Selected Philosophical Papers of Robert Boyle*. Manchester: Manchester University Press.

Ward, Keith (2008). *The Big Questions in Science and Religion*. West Conshohocken, PA: Templeton Press.

Wojcik, Jan (1997). *Robert Boyle and the Limits of Reason*. Cambridge: Cambridge University Press.

**Response to John Hedley Brooke’s Boyle Lecture**

**Geoffrey Cantor**

Professor Brooke has emphasized both the continuities and discontinuities between Boyle’s world and our own. Let me continue this theme by examining the Boyle Lectures themselves, of which this evening’s is such an impressive example. The current series of annual Boyle Lectures was established in 2004 by Michael Byrne and administered by a board of eminent trustees. This series focuses on the interrelations between theology and the sciences, a topic which – as we have heard – was of considerable importance to Boyle. The present series also continues the highly-regarded tradition that began in 1692 with the first Boyle Lectures – or, more precisely sermons – delivered by Richard Bentley, a young Anglican chaplain. Yet the link between Bentley and ourselves is not continuous. During the first few decades the lectures were delivered annually but became increasingly intermittent by the mid eighteenth century and finally petered out at the beginning of the twentieth.

What, then, is the relation between Robert Boyle and the original Boyle Lectures? The scope of the lectureship was specified by Boyle in a codicil added to his will on 28 July 1691, when he was putting his affairs in order and just five months before his death. He appointed four Trustees. Boyle directed his Trustees to appoint a “learned divine, or preaching minister” at an annual salary of £50 a year, and specified three duties that the incumbent should perform. I will return shortly to the second and third duties, but start with the first, which was “to preach eight sermons in the year for proving the Christian religion against notorious Infidels, *viz.* Atheists, Theists, Pagans, Jews, and Mohometans, not descending lower to any controversies, that are among Christians themselves …”

Not surprisingly the scope of the present series of Boyle Lectures bears little relation to the details specified in Boyle’s will. Our excellent lecturer this evening is certainly learned, but not a learned divine. He has distilled a great deal of wisdom into one lecture, not eight, and I hope his annual salary during his university career was not pegged at £50. Moreover, in addressing the relation between science and religion he has not attempted to prove “the Christian religion against notorious Infidels”.

To appreciate the first duty specified in Boyle’s codicil we need to recognise his lifelong concern to develop compelling arguments in support of Christianity. He did this with great skill and determination using all the resources he could muster. He particularly appealed to the power of reason, although he acknowledged that some aspects of Christianity were above reason (such as predestination). Within this broader project he often appealed to arguments from science, especially, as we have heard from John, the argument from design. However, in many of his writings he also deployed arguments that were unconnected with science. Thus science-related arguments were just part of a larger programme to advance Christian apologetics.

If we now turn to the early Boyle lectures themselves, historians have tended to overemphasise their scientific content; a tendency that received much impetus from Margaret Jacob’s 1976 book, *The Newtonians and the English Revolution*. Richard Bentley certainly exemplifies Jacob’s characterisation as he addressed the structure of the world drawing especially on Newton’s theory of matter and forces. Primed by Newton himself, Bentley provided one of the first public expositions of the Newtonian system and utilized it to argue against the atheistical atomism associated with Epicurus. By contrast Newton’s system required a divine Creator and was continually under God’s control. Although Bentley made a few references to Boyle’s scientific views, it is surely ironic that this first series of Boyle Lectures offered unqualified support for Newton’s science, not Boyle’s.

A few of the subsequent Boyle Lectures possessed extensive scientific content, such as 1711 and 1712 series delivered by William Derham, the rector of Upminster, under the title *Physico-Theology: or, a Demonstration of the Being and Attributes of God, from His Works of Creation*. However, as Chris Kenny has forcefully argued, the Jacob thesis leads us to misinterpret the early Boyle Lectures by concentrating on those that used science for apologetic purposes and ignoring the vast majority that possessed little or no scientific content. We gain a far more balanced view if we see the early Boyle Lectures as typical examples of contemporary ecclesiastical rhetoric using any and all resources at hand to fight the infidel. These included arguments from the natural world using science but also an array of traditional rational arguments that do not depend on science.

But let’s look more closely at the list of infidels cited in Boyle’s codicil: “Atheists, Theists, Pagans, Jews, and Mohometans”. Historians have emphasised the problematic nature of these terms and the way they were employed in theological controversy. Yet these groups were often identified as posing a major threat to Christianity. Bentley considered that the most dangerous enemies of Christianity were atheists, and he observed that “not one English Infidel in a hundred is any other than a Hobbist; which I know to be rank Atheism”. Thus his Boyle Lectures, which were entitled *A Confutation of Atheism*, were primarily directed against the followers of Thomas Hobbes. Boyle himself would doubtless have included the Hobbists among the atheists, but also the adherents of other atheistical philosophies. For seventeenth-century Christians atheists were deemed intellectually incompetent, stupid and perverse in denying God’s existence; therefore they needed a strong dose of rational theology to dispel their delusions – just what Bentley offered in his series of Boyle Lectures. Unfortunately I don’t think this strategy will work with Richard Dawkins!

I don’t have time to unpack the term “Theists”, other than to point out a significant overlap with “Atheists” in their denial of Christianity and of the Christian God. The last three terms – “Pagans, Jews, and Mohometans” – refer to adherents of other religions. Let me focus on Jews for a moment as Boyle (like many contemporary Protestants) was immensely interested in the Jewish religion. As Michael Hunter has noted, Boyle engaged in serious religious discussions with Jews in England, Florence, and Amsterdam – including with Menasseh ben Israel; he studied Hebrew and compiled his own Hebrew grammar. One significant and relevant point emerges in Boyle’s reaction to Cromwell’s proposal in the mid 1650s to readmit Jews into England. Boyle favoured this, partly because he saw Jews as conveyors of important religious ideas but he also probably shared the messianic hope that the restoration and subsequent conversion of the Jews would speed Christ’s second coming. Yet he expressed concern that if Jews were readmitted they would gain converts from Christianity because of their superior ability to mount arguments. He therefore proposed that some Christians should acquire expert knowledge of Judaism so as to counter the arguments of the Jews – a theme reflected in this part of the codicil to his will.

Returning to the text of the codicil, Boyle also directed the lecturer not to descend “to any controversies, that are among Christians themselves”. During Boyle’s lifetime – which spanned the Civil War, the Restoration of the Monarchy, and the English Revolution – bitter controversies raged both within the Established Church and between the Church of England and a vast array of non-conformist groups. Although Boyle was an Anglican, he avoided aligning himself with any one party but instead repeatedly preached toleration to a remarkable degree. Of the four Trustees he appointed for the Lectureship, two were Anglican (Thomas Tenison, who was ordained, and John Evelyn) and the other two (Henry Ashurst and John Rotherham) were dissenting laymen. It is significant that he did not include Catholics among “notorious Infidels” – they would have topped the list for many contemporary Protestants. Although his objections to Catholicism were manifold, he had nevertheless attended a service in Florence at which the Pope officiated. By implicitly including Catholics within the Christian fold he signalled that he did not wish the Lectures to be used for anti-Catholic tirades.

We can now move on to the second of the three duties required of the lecturer: “to be assisting to all companies, and encouraging of them in any undertaking for propagating the Christian religion to foreign parts”. This was a continuation of Boyle’s own philanthropic and missionary activities. For example, he had been a director of the East India Company, using his position to support missionary work. He also sponsored the translation of the Bible and other religious works into several native languages. This second duty of the Lecturer also intersects with the first duty which specified “pagans” and “Mohometans” among those in need of conversion.

The lecturer’s third and final duty was “to be ready to satisfy such real [religious] scruples, any[one] may have concerning these matters, and to answer such objections or difficulties, as may be started, to which good answers have not yet been made”. This may seem rather a trivial matter compared with the other two duties required of the lecturer, but it enables us to appreciate a crucial aspect of Boyle’s religion and even intersects with his science. It is clear that Boyle himself experienced deep scruples – doubts – over religious issues. In his extensive writings on Christianity he deployed reason and analysed religious texts closely not only to convince others but also, in part, to address his own doubts. Many of his contemporaries described him as immensely pious. It is said that in conversation he always paused after the word God in order to reflect briefly on the Almighty. Yet Boyle’s piety involved a continual interrogation of his own thoughts and actions.

John earlier emphasised that we have difficulty understanding Boyle’s science because science has changed so much during the third of a millennium that separates him from ourselves. I would also suggest that the religious sensibilities of the seventeenth century are nearly as foreign to us as is Boyle’s science. The very notion of piety seems alien to our institutionalised religion as does a related activity that Boyle pursued extensively. In striving to live a Christian life Boyle engaged in casuistry – that is the use of reason to resolve issues of conscience, especially in determining how to fulfill his duties as a Christian. For example, Boyle, the pious Christian, grappled with the issue of taking oaths since some Christians, most notably Quakers, viewed swearing oaths as religiously objectionable. In working through issues that oppressed his conscience he employed several of his clerical friends as confessors.

As Michael Hunter and Chris Kenny have argued, Boyle’s aspiration to live as a pious Christian, to propagate Christianity, and to conquer all scruples provide a key to understanding him. These concerns not only lie at the heart of his explicitly religious writings but also, as Kenny has suggested, they underpin his plan for the annual series of sermons – the Boyle Lectures – which was “the public equivalent of the examination of scruples and the resolving of doubts according to an application of right reason”. Likewise it can be argued that Boyle’s scientific activities were directed to realising these same aspirations. This is not the place to argue this point in detail, but let me conclude by reminding you of the full title of his 1690 book *The Christian Virtuoso* which is *The Christian Virtuoso Shewing that by Being Addicted to Experimental Philosophy, a Man Is rather Assisted than Indisposed to Be a Good Christian*. Boyle used science in the service of being “*a Good Christian*”. He did not undertake his experimental researches solely in order to discover the structure of the world, which he recognised as God’s creation, but also and most importantly to advance his aspiration to be a good Christian. This is not a justification of science that is likely to appeal to the present-day research councils, but Boyle was very wealthy and he was blissfully ignorant of the meaning of the acronyms EPSRC [Engineering and Physical Science Research Council] and MRC [Medical Research Council]. Instead, science, for Boyle, ultimately served religious ends.

The Trustees are pleased to announce that next year’s Boyle Lecture will be given by

Professor Jürgen Moltmann

Jürgen Moltmann, Professor Emeritus of Systematic Theology at the University of Tübingen in Germany, is one of the most widely read theologians of the second half of the twentieth century. Moltmann was born in Hamburg, Germany, on 8 April 1926. He states that he grew up in a secular home, without significant Christian influence. As a boy he wanted to study science and mathematics. However in 1944, his education was interrupted when he was drafted by the German army. Moltmann was sent to the front lines in the Belgian forest. He surrendered in 1945 to the first British soldier he met.

For the next few years (1945–1948), he was confined as a prisoner of war and moved from camp to camp. First held in Belgium, he was later moved to Scotland and then to northern England. His experience as a POW had a powerful impact on his life, as it was in the camps that he had time to reflect upon the devastating nature of the Second World War. It was also in the camps that Moltmann met Christian chaplains, was given the New Testament and Psalms to read, and had his first introduction to Christian theology. Moltmann reflects about the war experience: ‘In July 1943 I was an air force auxiliary in a battery in the centre of Hamburg, and barely survived the fire storm which the Royal Air Force's “Operation Gomorrah” let loose on the eastern part of the city. The friend standing next to me at the firing predictor was torn to pieces by the bomb that left me unscathed. That night I cried out to God for the first time: “My God, where are you?” And the question “Why am I not dead too?” has haunted me ever since’.

When the war was over, Moltmann returned to his home in Hamburg. As a result of his reading the Bible and theological texts in the POW camps and attending the Student Christian Movement conference in the summer of 1947 with a group of POWs, Moltmann decided to pursue theological training. He received his doctorate from the University of Göttingen, under the direction of Otto Weber in 1952. From 1952 to 1957 Moltmann was the pastor of the Evangelical Church of Bremen-Wasserhorst.

In 1958 Moltmann became a theology teacher at an academy in Wuppertal that was operated by the Confessing Church and in 1963 he joined the theological faculty of Bonn University. He was appointed Professor of Systematic Theology at the University of Tübingen in 1967 and remained there until his retirement in 1994. From 1963 to 1983, Moltmann was a member of the Faith and Order Committee of the World Council of Churches. From 1983 to 1993, Moltmann was the Robert W. Woodruff Distinguished Visiting Professor of Systematic Theology at Candler School of Theology at Emory University in Atlanta, Georgia. He delivered the Gifford Lectures at the University of Edinburgh in 1984–1985. Moltmann won the 2000 Louisville Grawemeyer Award in Religion for his book *The Coming of God: Christian Eschatology.*

Moltmann married the feminist theologian Elisabeth Wendel in 1952; they have four daughters.

Moltmann has contributed many books to the field of theology, including *Theology of Hope* (1964), *The Crucified God* (1972), *Man* (1974), *The Church in the Power of the Spirit* (1975), *The Trinity and the Kingdom of God* (1980), *God in Creation* (1985), *The Way of Jesus Christ* (1989), *The Spirit of Life* (1991), *Theology of Hope: On the Ground and the Implications of a Christian Eschatology* (1993), *The Coming of God* (1995), *How I Have Changed: Reflections on Thirty Years of Theology* (1997), *The Source of Life* (1997), *God for a Secular Society* (1998), *Experiences in Theology* (2000), *Science and Wisdom* (2003) and *In the End—The Beginning: The Life of Hope* (2004). Books co-authored with his Dr. Elisabeth Moltmann-Wendel include *Humanity in God* (1983), *God-His and Hers* (1991), and *Passion for God: Theology in Two Voices* (2003).