Peter Harrison's Territories of Science and Religion*: A Symposium*

with Peter C. Kjærgaard, "Why We Should Care about Evolution and Natural History"; Kaspar von Greyerz, "Early Modern Protestant Virtuosos and Scientists: Some Comments"; Nathan J. Ristuccia, "Peter Harrison, Ludwig Wittgenstein, and the Problem of Pre-Modern Religion"; Michael Fuller, "Into Terra Incognita: Charting beyond Peter Harrison's The Territories of Science and Religion*"; and Peter Harrison, "The Modern Invention of 'Science-and-Religion': What Follows?"*

EARLY MODERN PROTESTANT VIRTUOSOS AND SCIENTISTS: SOME COMMENTS

by Kaspar von Greyerz

Abstract. The following essay is divided in three parts. First, while sharing in principle Harrison's hypothesis of an affinity between the sixteenth-century Reformation and early modern science, it questions the connection between the latter and the Weberian "disenchantment of the world." Second, it suggests a broader group of possible actors than that envisaged by Harrison in referring to virtuoso collectors and their cabinets of curiosities who are rather marginalized in Harrison's narrative. And third, it highlights (in agreement with Harrison) the physico-theology of the second half of the seventeenth and the first half of the eighteenth century and beyond as an important temporary fusion of religion/theology and science at a time when the new science was still striving for social and religious respectability.

Keywords: continuities in nature symbolism; differences between natural theology and physico-theology; early modern science and the "disenchantment of the world"; physico-theological bestsellers; physico-theology as a seventeenth- and eighteenth-century phenomenon; seventeenth-century alchemy; virtuoso collectors and their significance

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When the late nineteenth-century authors John William Draper (1811–1882) and Andrew Dickson White (1832–1918) construed their thesis of a fundamental, age-old conflict between religion and science they could be certain to appeal to contemporary sensibilities shared by many readers not only in the Anglo-American world but also on the European continent.

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 ISSN 0591-2385

In Europe, Protestant resentment of alleged Catholic antimodernism had reached new heights following the First Vatican Council's proclamation of papal infallibility in 1870.

Peter Harrison rightly rejects these and other mythical interpretations of the history of science. For a historian of early modern Europe, such as myself, he is "running in open doors," but he is undoubtedly correct in reminding us that such fundamentally erroneous notions are still *en vogue* in some quarters (Harrison [2006] 2011a, 118; 2015, 24, 51f., 172).

The Allegorical Reading of the Book of Nature

Harrison finds himself in agreement with most salient research of the last decades in highlighting the seventeenth century, particularly in England, as a landmark in terms of redefining the relationship of religion and science, conveying to it a form that was to last (in England) until the first half of the nineteenth century. One important aspect, which was to feed into the physico-theological movement in the course of the second half of the century, was the increasing emphasis on the usefulness of science, understood in anthropocentric terms. This went hand in hand with the popularization of the Baconian motif of the possibility of human dominion over nature (Harrison 2015, 126, 138–40f.). In other words, it became possible to conceive of progress, specifically as something "arising out of the cumulative contributions of numerous individuals to a body of knowledge" (Harrison 2015, 119). Harrison argues that the establishment of transpersonal, collective bodies of doctrine in the wake of the Reformation paved the way for this new definition of *scientia* and *religio* (Harrison 2015, 11, 16, 93). However, as the following will show, I doubt whether that which undoubtedly applies to the new role of religion is likewise applicable in a comparable way to science.

Elsewhere, Harrison has pointed out that the sixteenth-century reformers consciously opted for the literal or historical sense in interpreting the Bible, thus rejecting allegorical interpretation, and, more generally, the medieval conception of the fourfold meaning of biblical texts (Harrison 1998, passim; Harrison [2006] 2011b, 198, 204). This allowed for a new approach to the Book of Nature. I do not question that a literal or historical reading of the book of Genesis, in particular, *may* have had "a major impact on the development of experimental science in seventeenth-century England" (Harrison [2006] 2011b, 210). It is nonetheless possible that the Reformation did not represent the kind of exegetical caesura suggested by Harrison (Van der Meer and Oosterhoff 2008). However, assuming that it did, I question the linearity of the "disenchantment of the world"—a notion evidently borrowed from Max Weber—which is invoked to buttress "the admittedly risky proposition that modern science, and indeed

modernity in general, is in some way deeply indebted to Protestantism" (Harrison [2006] 2011b, 211).

In the *Fall of Man and the Foundations of Science*, Peter Harrison argued that in seventeenth-century science "it is experimental philosophy that is most indebted to Calvinist ideas of human nature. Here we encounter a critical scrutiny of human faculties along with frank appraisals of their inherent limitations. . . . [that] the commitment to the pursuit of knowledge would be partial and probable, that it would be attained only after much drudgery and labor, and that it would require the coordinated efforts of many individuals" (Harrison 2007, 249). However, we should by no means overlook the deeply ambivalent role of Calvinism, or better, Reformed theology, in seventeenth-century science. The Dutch Calvinist neo-scholastics such as Gisbert Voetius (1589–1676) and his adherents, made every effort to stop the spread of Cartesianism within Dutch learned culture, and while doing so, they claimed to be the true torchbearers of original Genevan Calvinism (Vermij 2002, 239–331). This spilled over into the Reformed camp in Switzerland, where resistance against Cartesianism reached its climax with the Reformed churches' *Formula Consensus* of 1675 that even declared the diacritical signs in biblical Hebrew texts to be divinely inspired. Here, the literal interpretation of the Bible turned into a boomerang *against* the promotion of the new science. The Reformed authorities of Zürich reprimanded Johann Jakob Scheuchzer as late as 1721 for his public backing of Copernicanism (Nagel and Gehr 2012, 194f.). All this was not in keeping with the alleged disenchantment of the world initiated by the Reformation.

The relatively cautious connection established between the reformers' rejection of the fourfold meaning of biblical texts in favor of a literal or historical reading and the rise of the new science in the course of the seventeenth century in *The Territories of Science and Religion* is the main theme of Harrison's *The Bible, Protestantism, and the Rise of Natural Science* of 1998. Here, the author acknowledges the discussions of the Weber-Tawney approach to the socioeconomic role of early modern Calvinism and, in particular, the extension of this approach into the history of seventeenth-century science by Robert Merton ([1938] 1978) and Charles Webster (Webster 1975). Given the ambivalent result of these debates, he insists that neither Calvinism nor Puritanism provide the specific background for his study and that, as a result, he intends to focus more generally on the impact that the sixteenth-century reformers' insistence on the literal interpretation of scripture had on the relationship between *Protestantism* and science. In spite of his declared distance to the arguments proferred by Weber and Tawney, his main argument here, as well as in his last monograph of 2015, is very much part of a Weberian view of the "disenchantment of the world" in the wake of the Reformation. Weber's larger and more lasting concern, of which "The Protestant Ethic" was just one

component, was the unstoppable rationalization of the Western world which filled him, on the one hand, with admiration, on the other, with an almost dystopian concern (Schluchter 1981, 2009).

Peter Harrison has made it clear that he does not wish "to be seen as setting out a monocausal thesis for the rise of modern science, for there is no reason why a range of factors should not play the same role," yet he insists that "the literalist mentality initiated by the Protestant reformers, and sponsored by their successors" was "the most significant" of these factors (Harrison 1998, 8). *The Territories of Science and Religion* keeps endorsing this view. In what follows, I want to question Harrison's hierarchical ranking of the factors in question (for some preliminaries cf. von Greyerz 1999).

John Hedley Brooke's important *Science and Religion* provides a good illustration of the intimate connection between the new "literalist mentality" of the reformers and the Weberian conception of the disenchantment of the world. Much like Harrison after him, he argues that the reformers' emphasis on the literal reading of the Bible could "assist in the disenchantment of nature" (Brooke 1991, 71). He refers to Thomas Erastus's (1523–1583) criticism of judicial astrology based on a close literal reading of the first chapter of Genesis and argues that "the refusal of Erastus to derive the forms of bodies [on earth—KvG] from the stars, or from anything within nature, pointed toward the empiricism of Bacon, for whom the only guides to knowledge were experience and the Bible" (Brooke 1991, 71). However, his choice of a witness is, in a sense, indicative of the problems of continuity inherent in the disenchantment thesis, and this for two reasons. First, the most severe criticism of judicial astrology was voiced before the Reformation by Giovanni Pico della Mirandola (1463–1494). In his recent monumental history of Copernicanism, Robert Westman shows how Pico's misgivings kept inspiring similar criticism all through the sixteenth century (Westman 2011; 2013, 115–22). As far as the German Reformation is concerned, we should be aware that, among the two most prominent Wittenberg reformers, it was Philipp Melanchthon, who, unlike Luther, showed a keen interest in natural philosophy generally, and in astrological predictions in particular (Caroti 1986; Kusukawa 1995, passim).

Second, while questioning the *raison d'être* of judicial astrology, Erastus was at the same time very much involved in the contemporary controversy about how to deal with witches. Although Erastus spiritualized witchcraft as something which happened in the witches' thoughts rather than in real action, just like Johann Weyer, whom he fought bitterly, he nonetheless called for their execution on account of their apostasy (Gunnoe 2011, 352–58; von Greyerz 2012, 125–27). No sign of disenchantment here. In fact, as Stuart Clark has shown, the majority of the sixteenth- and seventeenth-century authors of demonologies had an evangelical-clerical background (Clark 1997, 437–56; Walsham 1999, 25–28). The *dénouement* of many

of these complexities, which make it difficult to look at the sixteenth and seventeenth centuries in terms of the disenchantment of the world, took place during the last decades of the seventeenth and the early eighteenth century. This is when the educated classes lost their interest in astrological prediction (Capp 1979, 190, 276–81; Curry 1989, 45–91; von Greyerz 1996), as well as in the persecution of witches (Sharpe 1997, 211–302), and when the movement of physico-theology got off the ground.

All this goes to show that implicitly wedding the reformers' insistence on a literal reading of Holy Scripture and the Book of Nature *with* the notion of the disenchantment of the world must inevitably result in a *mésalliance*. By insisting that an allegorical reading of the Book of Nature was henceforth on the way out, this view implicitly adopts a teleology which ultimately fails to do justice to the complexity of the development of seventeenth-century science. For there is an important tradition of scientific reasoning which clearly does not fit the concept of the disenchantment of the world. It is the alchemical tradition which perpetuates an allegorical reading of the book of nature all the way down to the end of the seventeenth century, when Isaac Newton moved from Cambridge to London, where he became Master of the Mint, and consequently gave up his laboratory (Westfall 1984, 332; Golinski 1988). There is no need to rehearse the difficulties that the research into this tradition had to overcome before it got integrated into the mainstream narrative of the Scientific Revolution. It is well known by now that the majority of the unpublished papers left by Newton deal with alchemical questions (Dobbs 1975, 235–48).

That a similar case can be made for Boyle is perhaps still less established. Few Boyle specialists would still call Boyle "the father of modern chemistry" (Harrison 2015, 103). Rose-Mary Sargent legitimized this view twenty years ago (Sargent 1995, 70). However, I am not aware that any other authoritative authors would have done so since then. While Jan C. Wojcik makes clear the extent to which Boyle's *Sceptical Chymist* of 1661 has long been misinterpreted in order to justify a "modern" view of Boyle's corpuscularianism (Wojcik 1997,133), he notes in the preface to his study that "'the father of modern chemistry' was not a scientist who dabbled in alchemy on the side" (Wojcik 1997, ix). I have associated myself with this view (von Greyerz 2015), particularly in connection with Boyle's reliance on alchemical insights offered by the Wittenberg medical professor Daniel Sennert (1572–1637).

The new view of the place of Sennert in the seventeenth-century history of science has been driven home by William Newman in a number of articles and, in particular, by his incisive study *Atoms and Alchemy* (2006). In this monograph, Newman squarely places the corpuscular theories of Sennert and Boyle in a tradition going back as far as the late thirteenth century, when an author who named himself "Geber," and whom he identifies as Paul of Taranto, wrote his *Summa perfectionis* (Newman 2004,

72, 274f.; Newman 2006, 26; Klein 2014). At the same time, Newman is able to demonstrate that, as far as the early modern period is concerned, this was an experimental tradition. Boyle certainly had no qualms in combining a literal and an allegorical reading of the book of nature.

In short, if we look at the long-term development of modern science, it appears plausible to me that a literal reading of the Bible and the Book of Nature was highly influential. However, as far as the outcome of late seventeenth-century mechanical philosophy is concerned, it is not really clear to me whether we should accord priority to this factor. Alchemy was by definition an allegorical way of approaching the secrets of nature and it unquestionably played an important role in shaping the scientific thought of the two most prominent exponents of Britain's late seventeenth-century science, Boyle and Newton. To conclude that the concern for these and other contemporary scientists for hermeticism, alchemy, and biblical prophecies simply were "indicative of an unconscious reluctance to admit the failure of the old world picture" (Harrison 1998, 271) does not really do justice to the relevant research of the last decades.

The Role of Virtuoso Collectors

Who are "the relevant historical actors?" Peter Harrison refers to them in passing (52), and seems to take the answer for granted. However, in methodological terms this raises important questions regarding the conceptual approach the author has opted for. In the present context, this is so because the methodological orientation of conceptual history or *Begriffsgeschichte* initiated during the 1960s by Quentin Skinner in Britain and Reinhart Koselleck in Germany tends to privilege knowledge claims over the process of knowledge making (Koselleck 1968; Skinner 1969), because the contextuality they invoke is above all of a *textual* kind.

To be sure, the most unhelpful discussions of newly published works are those that try to tell the author that he should have written a different book. As I have no objection to Harrison's highlighting the seventeenth century as a watershed in the development of the relationship of science and religion, I will thus limit myself in this second part of my essay to opening the spectrum of the relevant historical actors who participated in this transformation.

In 1685, when John Aubrey (1626–1697) completed his *Naturall Historie of Wiltshire*, his book (which remained unpublished) contained a compilation of observations in and of nature, as well as accounts of the experiences of the preternatural and supernatural. This included stories of witches, the apparition of ghosts, confirmations of the unexplainable fate of some families and of divine omens. It was not a blind compilation; Aubrey qualified a few of them as "impostures" (Hunter 1975, 102f.). John Aubrey was an early member of the Royal Society and he used some

of the regular meetings to inform those present about his observations. These concerned improvements in agriculture, all kinds of recipes, the tide, winds, fog, earthquakes, monsters, and fossils. At one point he also enlightened the assembly about an excellent beer produced without hops (Hunter 1975, 96). Another virtuoso to be mentioned here, likewise an early member of the Royal Society, was Elias Ashmole (1617–1692). He can be seen as somebody who tried to carry on the magical tradition established by John Dee, but, at the same time, he was also a collector of plants, minerals, coins, and other curiosities. He inherited the remarkable cabinet of curiosities assembled by John Tradescant the elder (d. 1638) and his descendants, which formed the basic collection of the Ashmolean Museum founded in 1682. Its first curator was Robert Plot (1640–1696) (Hunter 1981, 142; MacGregor 1985, 149–52).

Robert Plot was the author of the *Natural History of Oxford-shire*, which was published in 1677. Michael Hunter has categorized this *History* as a typical example of the almost blind empiricism of some of the virtuosi among the early members of the Royal Society who engaged in a Baconian sort of collecting (Hunter 1975, 93f.). Elsewhere he has qualified Bacon's conception of collections as a basis for natural history, "the store of data from which hypotheses were to be inductively derived," as "perhaps his [Bacon's] most significant methodological legacy to seventeenth century science" (Hunter 1981, 18; see also Daston and Park 1998, 220–31). At first sight this seems to contradict Hunter's view of Plot's *History*, but in fact it does not because, first, even the most inchoate collections contained, as it were, the seeds of later taxonomy, and secondly, for many contemporary virtuosi they confirmed their impression of the marvels of God's creation. I do not share Harrison's largely negative view of these efforts, as he inherently tends to judge them from the vantage point of historically more recent taxonomies (Harrison 1998, 90f.). The search for taxonomic order became evident when, in 1669, the botanist Thomas Willisel was sent out into the country by the Royal Society to collect objects that could fill lacunae in the Society *Repository* (Hunter 1985b, 164).

From natural histories we are turning to an only very slightly different context. Contemporary cabinets of curiosities, such as the *Repository*, and the early natural histories were close relatives. Cabinets of curiosities served as a *theatrum memoriae* with increasingly encyclopedic aspirations from about 1700 onwards (MacGregor 1985, 155f.) and, before that time, helped the beholder "to understand God's creation," such as, for example, King Gustavus Adolphus's cabinet, which closely connected the book of nature with Scripture (Boström 1985, 95, 101; Daston and Park 1998, 255–60). The Bible was represented by innumerable illustrations which were joined to the collection's objects. In mid-August 1657, the architect Joseph Furttenbach (1591–1667), a staunch Lutheran, employed a local cabinetmaker to construct a model of Noah's Ark for his *Kunstkammer*.

This was subsequently inspected by "ecclesiastical and lay persons of high and low estate" who discussed the model's pros and cons and, in some cases, the owner had to defend himself and the craftsman, that they had had no intention actually to imitate God's work (Furttenbach 2013, 250). Furttenbach, councilor of the imperial city of Ulm, was evidently very proud of his cabinet of curiosities, not least because it attracted many local as well as foreign visitors (Siebenhüner 2013). It was still relatively rare to allow the general public access to one's collection; in England at the time it was only the Tradescants who did so (MacGregor 1985, 150).

In *The Advancement of Learning* (1605), Bacon distinguished between three kinds of natural history: "of Nature in Course; of Nature Erring, or Varying; and of Nature Altered or wrought, that is History of Creatures, History of Marvailes, and History of Arts." He observed that there were enough works concerning the normal course of nature, but complained that there existed "no sufficient, or competent Collection of the Workes of Nature which have a Digression or Deflection from the ordinary course of Generations, Productions, and Motions" (Bacon 1633, 105). Events in nature that digressed from its ordinary course needed to be examined and described systematically. "A substantiall and severe Collection of the *Heteroclites* or *Irregulars* of *nature*, well examined and described I finde not: specially not with due reiection of fables, and popular Errrours [. . .]" (Bacon 1633, 105).

In his *Micrographia* of 1665, Robert Hooke noted in the preface in Baconian style that natural philosophers must not only study the common course of nature, but also its modifications, increases, and deviations, especially in areas where nature, as it were, tries to remain undiscovered: "The footsteps in Nature are to be trac'd, not only in her *ordinary course*, but when she seems to be put to her shifts, to make many doublings and turnings, and to use some kind of art in indeavouring to avoid our discovery" (Hooke 1665, Preface). To the overwhelming majority of the people involved in these discussions it was perfectly clear that nature is God's creation. It is necessary to underline this fact because many physico-theologians from the mid-seventeenth century onward made it their duty to denounce atheists in a sort of *unisono* refrain and in keeping within a tradition already prominent in the first half of the century (Hunter 1985a; Wojcik 1997, 77f., n. 5).

In 1664, Henry Power, likewise a member of the early Royal Society, explicitly invoked Bacon's authority in his treatise on *Experimental Philosophy* in a tone reminiscent of *New Atlantis*:

> These are the days that must lay a new Foundation of a more magnificent Philosophy, never to be overthrown: that will Empirically and Sensibly canvass the *Phænomena* of Nature, deducing the Causes of things from such Originals in Nature, as we observe are producible by Art, and the infallible demonstration of Mechanicks . . . . For Art, being the Imitation

> of Nature (or, Nature at Second-Hand) it is but a sensible expression of Effects, dependent on the same (though more remote Causes;). . . . I think it is no Rhetorication to say, That all things are Artificial; for Nature it self is nothing else but the Art of God. (Power 1664, 192f.)

God as master craftsman is a frequent theme in physico-theological treatises which I will address in the next section. Power identifies the main task of "onely the Experimental and Mechanical Philosopher . . . to find the various turnings and mysterious process of this divine Art, in the management of this great Machine of the World." He accuses the "old Dogmatists and notional Speculators" not to have gone to the trouble of getting to the bottom of things, and, as a result, not to understand more about nature "than a rude Countrey-fellow does of the Internal Fabrick of a Watch" (Power 1664, 193).

There are parallels between the research agenda of a Baconian sort of collecting in natural history and natural philosophy on one hand, and contemporary theology on the other. In the late 1650s, the Presbyterian minister Matthew Poole (c. 1624–1679) initiated a "Designe for registring of Illustrious Providences" based on the idea that, in the course of a cooperative venture, complete lists of providences could be compiled in every English county and subsequently joined and analyzed by Poole at Syon College. This was not a spillover of comparable Royal Society activities, as has been suggested, because extant letters addressed to Poole as part of his scheme date from 1657–1661 (Thomas 1971, 95, n.1). However, Keith Thomas is certainly not mistaken in noting "the close parallel with the methods used by the scientists of the Royal Society for collecting and classifying natural phenomena." He adds that "it is worth recalling that Francis Bacon had himself urged the desirability of compiling a definitive history of the workings of providence" (Thomas 1971, 95). Richard Baxter in fact communicated to Poole his desire to internationalize the project (Lamont 1979, 31). Poole's scheme did not come off the ground, but we are reminded of it in the preface to Increase Mather's *An Essay for the Recording of Illustrious Providences*, published in Boston in 1684.

The foregoing considerations should have highlighted the extent to which, in seventeenth-century Britain and beyond the Channel, the collecting of Baconian *heteroclites* in many cases not only served simultaneously natural and religious ends, but also that from today's vantage point it is difficult to separate these approaches when inspecting things at the grassroots level of history, as they were part of one and the same desire to know. The making of knowledge, which collecting as part of the early natural histories or of cabinets of curiosities entailed, made its way into scientific treatises. To name only two examples: John Ray (1627–1705) is known to have exploited Plot's *Natural History of Oxford-shire* for useable material (Hunter 1975, 93); and the Zürich physician and scientist

Johann Jakob Scheuchzer (1672–1733) entertained an impressive network of correspondents up and down the country for the collection of natural objects and facts and, between 1698 and 1702, drew up an inventory of Zürich's communal cabinet of curiosities (Rütsche 1997) with the aim of systematizing knowledge, comparable to similar efforts then undertaken in England by John Woodward, Hans Sloane, and others (MacGregor 1985, 155–58; Flubacher 2015, ch. 4). In considering such practice, it appears difficult to maintain as neat a categorical separation between natural history and natural philosophy as that applied throughout the *Territories of Science and Religion*. This will become even more evident when we look at physico-theology in the next section.

Physico-theology

One of the important differences between early modern natural philosophy and its modern successors "is that natural philosophy was unified by its search for a better understanding of God" (Blair 2006, 403). During the last couple of decades of the seventeenth century, natural history and natural theology merged in the new shape of physico-theology (Vermij 1993, 174). The third and last part of my essay is dedicated to this fascinating, and not sufficiently researched phenomenon. According to Peter Harrison, who pays it due attention,

> it reflects the conviction that what natural philosophers study is God's activity, both his direct causal activity and his design of the creatures. This is because divine causation is now considered to be more or less identical to natural causation, and because the theological significance of the creatures is no longer understood allegorically, but in terms of the way in which they have been designed. (Harrison 2015, 110)

Harrison distinguishes between physico-theology and physico-mathematics highlighted by Isaac Newton's *Principia Mathematica Philosophiae Naturalis* of 1687. However, I am not sure whether the history of physico-theology actually bears out this clear-cut distinction. The Zürich natural historian and scientist Johann Jakob Scheuchzer (1672–1733), for example, simultaneously resorted to both approaches (Kempe 2003, 154f.). On the other hand, it would be clearly wrong to see physico-theology as a branch of natural theology that actually sought to distance itself entirely from Newton's celestial mechanics and to favor a purely *a posteriori* approach, as Fritz Krafft has suggested (Krafft 1999, 77). Perhaps it might be more appropriate to distinguish between two forms of argument *within* physico-theology, namely cosmic and physical. Neal C. Gillespie has argued that Robert Boyle distrusted the cosmic argument because it implied the risk that simple objects it described could be regarded as a result of chance in terms of their origin and operation. Boyle, like many other physico-theologians "was concerned about the ability of men

to know the objects on which they based their natural theology" (Gillespie 1987, 27). Where this kind of specific experience resulted in arguing for the divine design of a specific object, the argument was based on final causes. This did not agree with Cartesian physics, which rejected final causes, but was perfectly compatible with the new experimental science (Vermij 1993, 177).

When looking at the period from about 1650 to 1750, we can distinguish four specific genres, and possibly even more. On the European continent the argument from design clearly was the dominating genre. The number of acrido-, bronto-, insecto-, litho-, testaceo-theologies, and so on that came off the presses is simply astounding. These treatises by and large concentrated on an individual creature or object, whereas much fewer physico-theological works (unsuccessfully) tried to encompass all of God's creation, such as, for example, the Dutch physician Bernard Nieuwentijt's *Het regt gebruik der Werelt beschowingen* [. . .] of 1715 (translated as *The religious philosopher: or, The right use of contemplating the works of the creator*, London 1718) or the Swiss physician Johann Jakob Scheuchzer's *Kupfer-Bibel* [. . .] or *Physica Sacra* of 1731–1735 (Sheehan 2003, 50–60). Other physico-theologians overstepped the boundary between revealed religion and natural philosophy and consecrated studies to immortality and the resurrection (Vidal 2003). I would call this a third, clearly distinguishable genre, albeit practiced by only relatively few authors. The many writings triggered in Britain and on the continent by Thomas Burnet's *The Sacred Theory of the Earth,* dealing with the shape of the earth from creation *via* the deluge to the apocalypse (Latin: 1681/1689; English, 1684/1690), constitute a fourth, clearly distinguishable genre.

Harrison has argued that the Cambridge Platonists in particular encouraged such an extension of the purview of physico-theology and that this transcended the traditional topics of natural theology. He has concluded that "for this period, then, physico-theology was not a sub-set of natural theology" (Harrison 2005, 175). I will return to this question at the end of this section.

For many physico-theologians rational explanations guided by the scriptural knowledge of final causes were not an end in itself; they aimed, at the same time, at a worship of the wonders of nature. Among the early exponents of the movement, John Ray provided a model for this in *The Wisdom of God Manifested in the Works of Creation* (1691). In the germanophone world this was celebrated especially by physico-theological poets, such as the Hamburg councilor Bartold Hinrich Brockes (1680–1747) (Brockes 1965; Fry 1989) or the Swiss physician and natural philosopher Albrecht von Haller (1708–1777) in his poem *The Alps* (1729), which expresses a sense of awe in front of the sublimity (*Erhabenheit*) of God's creation (Haller 1732). Elsewhere, God is repeatedly praised as the master-artist or master-craftsman (Stebbins 1980, 33). This pedagogical intention inherent

in much of this literature can be seen in the fact that the great majority of it appears in the vernacular and that authors who began writing in Latin eventually opted for the vernacular.

Across the Europe of the last third of the seventeenth century, there was a general learned tendency to forget about the punishing God of Baroque religious culture in favor of praising his goodness, as well as the usefulness of his creation for mankind (cf. Harrison 1998, 161–69). While some mathematicians, including Newton, continued to calculate the precise date of the end of the world (Popkin 1984), others, like the Platonist Henry More, envisaged a relatively smooth transition from the present to a millenarian future without any real apocalyptic caesura (van den Berg 1988). Eschatology, based on an allegorical reading of the relevant chapters of the Bible, was losing its appeal. This was one of the reasons why Burnet's *Sacred Theory of the Earth* sparked off a controversy (Stewart 1992, 33–41) and urged his opponents even more to prove the usefulness of creation and of biblical wonders, such as the deluge and its consequences. This party was later to be called the deluvianists (John Woodward, Johann Jakob Scheuchzer, Jakob Wilhelm Feuerlein, and others; Kempe 1996; 2003, 73–109).

When physico-theologians praised God's wisdom and goodness (*Güte* rather than *Gnade [grace]*) they had in mind a much more predictable divine being than the sixteenth-century reformers. This is mainly what their unwavering belief in God's *special* providence expressed. In Britain, this culminated in the work of Newton and the Newtonians. The doctrine of providence articulated in William Derham's seminal *Physico-Theology* of 1713, which was soon thereafter translated into several other European languages, was "based on a precise understanding of Newton's own contribution to the role of God in the world" (Stewart 1992, 53); "the regularities of nature were a manifestation of the continuous and direct activity of God" (Harrison 2015, 79). However, this should not be understood in the sense that Newton identified God with natural law: "There is no such thing as what men commonly call the course of nature. It is nothing else but the will of God producing certain effects in a continued, regular, constant and uniform manner," is how Samuel Clarke put it as Newton's amanuensis in the famous controversy with Leibniz (quoted in Brooke 1988, 183). Nothing could be more historically wrong than to assume that the providentialism of the physico-theologians helped them to cover up their deist convictions (Steiger 2005, 122; *pace* Michel 2008, 12). On the contrary, almost certainly the majority of their hundreds of treatises explicitly and often harshly attacked deism and atheism (Gillespie 1987, 23f.; Trepp 2009, 334). It would be exceedingly difficult to detect any deistic propensities in such works as Walter Charleton's *The Darkness of Atheism Dispelled by the Light of Nature. A Physico-Theological Treatise* (1652), or Bernard Nieuwentijt's *Het regt gebruik der Werelt beschowingen,*

ter overtuiginge van Ongodisten en ongelovingen (1715) [*Ongodisten* are atheists, *ongelovingen* unbelievers], to name only two out of countless possible examples.

In publishing his *Delectus Argumentorum et Syllabus scriptorum qui Veritatem Religionis Christianae adversus Atheos, Epicureos, Deistas seu Naturalistas, Idololatras, Judaeos et Muhammedanos lucubrationibus suis asseruerunt* (Selection of arguments and list of authors who by their labors have served the truth of the Christian religion against atheists, Epicureans, deists or naturalists, idolaters, Jews, and Muslims) in 1725, Johann Albert Fabricius, arguably *the* founding father of German physico-theology, joined the Boyle lecturers to whom Boyle's will of 18 July, 1691, assigned the task of "proving the Christian religion against notorious Infidels, *viz.* Atheists, Theists [meaning Deists—KvG], Pagans, Jews, and Mahometans, not descending lower to any controversies, that are among Christians themselves" (Hunter 2009, 239–41). Many, but by no means all, Boyle lecturers addressed physico-theological themes or Newtonian physico-theology. However, in the end, most of them helped to internationalize a chiefly Newtonian brand of natural theology that saw Newton "as a guarantor of [its] scientific accuracy" and underlined "the importance of the lawfulness of creation" (Mandelbrote 2013, 90).

The internationalization of natural theology becomes most visible in the production of physico-theological works. In what follows, I will limit myself to some preliminary remarks on seventeenth- and eighteenth-century book production based on library catalogues from Britain, France, Germany, the Netherlands, and Switzerland. Titles by William Derham and John Ray are the absolute front-runners. In Britain, between 1713 and 1768, Derham's *Physico-Theology* went through thirteen editions, which were followed by at least four "new editions" between 1768 and 1798. The treatise soon appeared in a French translation, which was published in three editions between 1726 and 1732, followed by a Dutch translation (1728) and a German translation published in three editions between 1730 and 1764. Derham's *Astro-Theology* appeared in Britain in thirteen editions between 1715 and 1769. A Dutch translation was published in 1728 and a French translation, likewise printed in Holland, a year later. Another late French version appeared in Zürich in 1760. In 1728, as well, Johann Albert Fabricius, that indefatigable promoter of British physico-theology on the continent, saw a German translation through the press, which (1728–1739) had three editions and was republished in Hamburg again in 1765.

In Britain, there were thirteen editions of John Ray's *The Wisdom of God Manifested in the Works of the Creation* between 1691 and 1756, and additional print runs thereafter in Glasgow, Aberdeen, and Edinburgh between 1768 and 1798. A French translation appeared in Utrecht in 1714 and a second French edition by the same publisher in 1729. A German translation by Caspar Calvör followed at Goslar in 1717–1718. There also

was a Dutch translation, first published in Amsterdam in 1768 and, under a slightly different title, by the same publisher, in 1769. Another very popular work was Ray's *Three physico-theological discourses* . . . , originally entitled *Miscellaneous Discourses concerning the Dissolution and Changes of the World* (1692), which had its fourth edition in London in 1732. This was immediately translated into Dutch (1694) and reedited in Rotterdam in 1719. There was also a German translation, first published in Hamburg under the picturesque title *Sonderbahres Klee-Blätlein* . . . (curious cloverleaf), and republished under different titles in Leipzig in 1732 and 1756.

Samuel Clarke's Boyle lecture *A Demonstration of the Being and Attributes of God, more particularly in answer to Mr. Hobbs, Spinoza, and their followers* went through ten editions in Britain between 1705 and 1767. A French version was published in Amsterdam in 1717, and again in 1727–1728. Not all English-language treatises were translated directly into other European vernaculars. In the case of some of the writings of Robert Boyle we can observe a different pattern. Several of them, which had been published in English, such as, for example, *The Excellency of Theology compar'd with Natural Philosophy* (1674) or *Some motives and incentives to the love of God* (1663), appeared in Geneva in a Latin version in 1696 and 1693, respectively. A German version of both Latin tracts was subsequently published at the Press of the Halle orphanage in 1708. This printing press was run by the Halle Lutheran Pietists, and the publication of Boyle's texts speaks to their doctrinal openness.

Although the history of the major publications of the physico-theological movement between 1650 and the later eighteenth century demonstrates that the initial stimulus originated in Britain and spread from there to the continent, this did not remain a one-way road from West to East. However, few continental physico-theological works made it all the way to the British Isles in the form of translations. Some works of the Dutchmen Jan Swammerdam and Bernard Nieuwentijt are exceptions to this rule. Swammerdam's original *Historia Insectorum Generalis* (1669) appeared in a French translation in 1682 at Utrecht. His major heritage, the *Biblia Naturae*, with a foreword by Hermann Boerhaave, published in two volumes in Leiden in 1737–1738, was translated into English by Thomas Flloyd and published in London in 1758. Six years earlier a German translation had appeared in Leipzig. The mathematician and physician Bernard Nieuwentijt's influential *Het regt gebruik der werelt beschouwingen* . . . of 1715 appeared in an English translation by John Chamberlayne three years later, and was republished in 1724. A French translation appeared in 1725 and again in 1727. The first German translation dates from 1732 and a second one was published at Jena in 1747.

Again, these bibliographical observations are preliminary. Further research will have to look into the operations of the individual printers and the quality of the translations. What the last paragraphs tentatively

convey is a sense of the intensity and the excitement of the transnational physico-theological discussion especially during the last decades of the seventeenth century and the first half of the eighteenth century. A study of the complementary correspondence networks would undoubtedly confirm this impression. Such studies have so far concentrated on individual cases or have been undertaken within a national context (e.g., Boscani Leoni 2007, 2012). Clearly, we are looking at an intellectual and religiocultural movement involving at the same time natural philosophers of some renown as well as an army of virtuosi. The size of the latter is mirrored, for example, by the hundreds of treatises demonstrating God's existence by design that appeared in the German-speaking world of the eighteenth century.

Several germanophone scholars of the last seventy years, beginning with Wolfgang Philipp's dissertation of 1957 (Philipp 1957, 1967, 1250–53) have claimed that early modern physico-theology is part of a tradition reaching back all the way to the church fathers (Waschkies 1988, 164f.; Michel 2008, 87–89), or they have located its inception in the Reformation or the immediate post-Reformation period (Krafft 1999, 81; Trepp 2009). Sara Stebbins was right in criticizing Philipp's undiscriminating attempt to label everything "physico-theological" that discussed the relationship of religion and science, and she warned that the historical continuities, in which early modern physico-theological authors placed themselves, should not be taken for granted (Stebbins 1980, 63f.). Peter Harrison, too, has argued convincingly that early modern considerations of contrivance and design should not simply be regarded as "the continuation of a medieval tradition of natural theology with a better and more objectively established data set. Rather, it was the institution of a new approach to nature that was at once more modest and more ambitious than the theologies of nature that preceded it" (Harrison 2015, 113f.) In a similar vein, Michael Kempe has located early modern physico-theology within a chronological frame spanning 130 years, from 1650 to 1780 (Kempe 2003, 155). Although 1780 might be too restrictive as a *terminus ad quem* in the British case, it does on other hand designate the period in which physico-theology was received most intensely on a European scale. Everywhere the movement increasingly had to face fundamental challenges after about 1750: many exponents of the Enlightenment now looked at the Newtonian universe from Voltaire's vantage point, which left no room for special providence; others had for some time begun to distance themselves from the traditional view of the age of the world. By 1775, the Comte de Buffon judged its age to be approximately 74,047 years (Leclerc 1775, 362). Continuing to assume that God had created all plants and animals and man during the biblical six days of creation was now much more difficult than it had been at the turn of the century.

"The intimacy between science and religion" (Brooke 1991), manifest in the movement of physico-theology lasted longer in Britain than in

Germany, where Immanuel Kant (1724–1804) dealt it a severe blow. In his *Der einzige mögliche Beweggrund zu einer Demonstration des Daseyns Gottes* (The only possible reason for a demonstration of the being of God), which went through three editions and four printings between 1763 and 1793, and in his *Critique of Pure Reason* of 1781, he decisively questioned the ability of physico-theological demonstrations to prove the existence of an omnipotent, wise, good, and just creator (Brooke 1991, 203–06; Krafft 1999).

In spite of similar criticism voiced by David Hume, British physico-theology weathered the challenges of the later eighteenth century better than its German counterpart (Brooke 1991, 209), doubtless aided by the fact that, unlike the European continent, Britain was able to manage the transition to the nineteenth century more smoothly. A series of lectures institutionalized next to the Boyle Lectures to assure the vitality of natural theology (Burnett Lectures, Warburton Lectures, Bampton Lectures), all the way to the eight volumes of Bridgewater Lectures published in 1833, gave expression to the unabating belief of the educated in the necessity of natural theology (Philipp 1957, 32). In the early nineteenth century, these tendencies and developments culminated in the publication of William Paley's enormously popular *Natural Theology* in 1802.

When Kant addressed the "impossibility of the physico-theological demonstration" in the *Critique of Pure Reason* (Kant [1781] 1787) he turned to a "specific experience" of the things in this present world, their quality and position which could serve as the basis of proving the existence of a supreme being: "Such a demonstration we would call the physico-theological argument (*Beweis*)" (Kant [1781] 1787, Transzendentale Dialektik, II, iv, 6). No wonder that Hans-Joachim Waschkies, a philosopher, could define physico-theology as a "branch" (*Seitenzweig*) of natural theology, "which comprises all attempts to demonstrate the existence, or at least the nature, of God independently of the Holy Scriptures or any other revelation" (Waschkies 1988, 172) and that Krafft could claim that the method of physico-theologians always consists of arguing *a posteriori* (Krafft 1999, 77).

Although the number of German treatises arguing from design is overwhelming, they do not make up the total of physico-theological treatises in the German vernacular within the period considered here. But to my knowledge, there are comparatively few germanophone works that try to use evidence gained from the study of the Book of Nature for an explanation of biblical revelation, such as parthenogenesis, the resurrection, the creation and the end of the world, other than Scheuchzer and his fellow "diluvianists," as well as Nieuwentijt. This clearly went beyond the traditional subject matter of natural theology and, in drawing attention to such phenomena, Harrison is undoubtedly right to conclude that "for this period, then, physico-theology was not a sub-set of natural theology"

(Harrison 2005, 175). It was more than that: simultaneously a kind of real disenchantment *and* a celebration of the sublime wonders of creation.

Dedication

This essay is dedicated to Hartmut Lehmann in the year of his eightieth birthday.

Acknowledgment

The author wishes to thank Ann Blair and Sundar Henny for their helpful comments on an earlier draft of this essay.

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