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## The Grand Business of Nature

### 6.1 The *Oeconomy* of Nature

Robert Boyle's status as a scientific pioneer, and the many emotional insecurities that this entailed may have fuelled his notorious feud with the formidable author of *Leviathan*.<sup>1</sup> But whatever the reasons for their enmity and whoever prevailed in their feud, it is certain that Boyle's philosophical work on natural law is mostly known nowadays only within specialist circles, while Hobbes, on account of his theory of natural law, is recognized today as the author of probably the most important theory of the state in modernity. The scope of Boyle's influence in the context of natural law is, however, another matter entirely. This chapter is concerned with just one aspect of Boyle's proposal regarding knowledge: the way in which he connected nature, theology and economy through science as a multiplier of sorts. The task of this chapter is thus to show how Boyle's new political system for an economics of natural science, primarily involving the utilitarian exploitation of nature and of trade, connected with his contribution to the development of natural law and natural philosophy, stripped of moral natural law. Natural law was thus rendered non-human. The theoretical problem that Boyle set himself to address was to ascertain the way in which the activity of matter (as opposed to spirit) related to God.<sup>2</sup> Descartes's denial of the activity of powers in

<sup>1</sup> 'Those Fellows of Gresham who are most believed, and are as masters of the rest, dispute with me about physics. They display new machines, to show their vacuum and trifling wonders, in the way that they behave who deal in exotic animals which are not to be seen without payment. All of them are my enemies.' Thomas Hobbes, 'Dedicatory Epistle to Samuel Sorbière', Hobbes's *Physical Dialogue* (1661). Boyle's and Hobbes's feud is described in Shapin and Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*, quote at p. 347.

<sup>2</sup> This appears so in different levels of theoretical abstraction in his works of natural philosophy, and is also clearly expressed: 'So that to me, who desire to have it explained how an immaterial Substance can move matter, and consequently, how God can do it, it will be no satisfaction to say, that the Rational Soul can move the Body 'tis joined to, since that Power

nature, against Aristotle and Aquinas's ideas, and his attribution of all the work in matter to God through his laws of nature may have acted as a spur to Boyle's work in the realm of natural philosophy.<sup>3</sup> Boyle, however, thought that human reason could carry out this theological exercise only by investigating matter. Remaining within the Baconian tradition, his goals were at once devotional and utilitarian: he sought to expand human beings' dominion over 'matter'. He did this as a transitional figure who operated within the broader intellectual context of early modern or Renaissance Europe characterized by the appearance of anti-Aristotelian perceptions of nature that increasingly enlarged the scope of human beings' dominion over it.<sup>4</sup> Theological principles about an omnipotent and bountiful God were crucial to Boyle's plans for the achievement of broader management of nature, but as a rule, he avoided consideration of anthropological theology in his scientific writings.<sup>5</sup> Boyle's idea of recovering the bountiful God might well be compared with the provident ruler that the Arminians had recovered half a century earlier. They rejected the punitive God of Calvin and asserted that by attributing reason, will and affection to human beings, which were only diminished not destroyed by the sin of our first parents, Adam and Eve, God provided human beings

is referred merely to God's appointment: and the question is, how God himself can be conceived to move matter.' Robert Boyle, 'Advices about Judging of Things Said to Transcend Reason. third advise.' in Michael Hunter and Edward B. Davis eds. *The Works of Robert Boyle vol 9. Publications of 1678–1683*, p. 404.

<sup>3</sup> The context of Cartesian occasionalism is presented usefully in Benjamin Hill, Henrik Lagerlund and Stathis Psillos 'Introduction' in the same eds. *Reconsidering Causal Powers: Historical and Conceptual Perspectives* (Oxford: Oxford University Press, 2021).

<sup>4</sup> Since the Second World War this argument has been explored with increasing degree of concern. In recent years it has accelerated with the intensification of the environmental crisis, R. G. Collingwood, *The Idea of Nature* (Oxford: Oxford University Press, 1978 [1945]) p. 93, partly intellectual history of science, partly an ecofeminist project in Carolyn Merchant, *The Death of Nature. Women Ecology and the Scientific Revolution* (San Francisco: Harper & Row, 1990). For Merchant, Newton's scientific work is the culmination of the death of nature through the conceptual world of corpuscularianism, domination and manipulation of nature and progressive economic development, while Boyle appears as a quite marginal figure; Bruno Latour, *We Have Never Been Modern*, Catherine Porter (trans.), (Cambridge: Harvard University Press, 1993); see also from a theological perspective, recently Jacob Holsinger Sherman 'Reading the Book of Nature after Nature' 11 *Religions* (2020). Boyle as a transitional figure between the Aristotelian system and experimental diversification of science in Anstey, *The Philosophy of Robert Boyle*, p. 4.

<sup>5</sup> This dualism is illuminated by Peter Harrison and John Henry's debate. See Peter Harrison, 'Voluntarism and Early Modern Science' 40 *History of Science* (2002); John Henry, 'Voluntarist Theology at the Origins of Modern Science: A Response to Peter Harrison' 47 *History of Science* (2009), p. 104; Peter Harrison, 'Voluntarism and the Origins of Modern Science: A Reply to John Henry' 47 *History of Science* (2009) 223–231.

with natural sociability.<sup>6</sup> Only Boyle, instead of focusing on the moral aspects, he worked with the material aspects of human beings' divine government. The disappearance of moral natural law from the concerns of seventeenth century natural philosophers, I argue, placed human beings outside nature and subjected nature to a new lord and master: the human being. The sophistication of Boyle's philosophical investigation of the concept of nature was instrumental to this endeavour.

The first important natural philosopher of the seventeenth century to describe nature as an *oeconomy* was Sir Kenelm Digby (1603–1665).<sup>7</sup> Peter Remien has recently reinstated Digby as the thinker of the *oeconomy* of nature, which, in Remien's view, was predicated on an ontology that

<sup>6</sup> James Moore, 'Calvinians, Arminians, Socinians: Popular Sovereignty and Natural Rights in Early Modern Political Thought', in Ian Hunter and Richard Whatmore (eds.), *Philosophy, Rights and Natural Law. Essays in Honour of Knud Haakonssen*, (Edinburgh University Press, 2019), p. 23.

<sup>7</sup> Kenelm Digby, *Two Treatises: In the One of Which The Nature of Bodies; in the other, The Nature of Mans Soule, is Looked Into* (London: Print. for John Williams, 1645). Digby combined mechanic philosophy, a species of atomism and Aristotelianism. According to Antonio Clericuzio he was one of the most influential natural philosophers of mid-seventeenth century, see, Antonio Clericuzio, *Elements, Principles and Corpuscles. A Study of Atomism and Chemistry in the Seventeenth Century* (Springer, 2000), p. 81. A political interpretation of why despite his brilliance as a thinker Digby remained in his time and in historiography an outsider, in a word, because as a Catholic he had his own agenda for the new science, John Henry, 'Sir Kenelm Digby, Recusant Philosopher' in G. A. J. Rogers, Tom Sorrell and Jill Kraye (eds.) *Insiders and Outsiders in the Seventeenth Century* (London and New York: Routledge 2009); a helpful overview of his natural philosophy by Betty Jo Dobbs, 'Studies in the Natural Philosophy of Sir Kenelm Digby', 18 *Ambix* (1971) 1–25; see also about Digby's project of illuminating the historical corruption of Aristotle's philosophy and thus of blocking Pomponazzi's materialist Aristotelianism, and about Digby in England and his displacement by the new Epicureanism, Dmitri Levitin, *Ancient Wisdom in the Age of the New Science. Histories of Philosophy in England, c. 1640–1700* (Cambridge: Cambridge University Press, 2015), pp. 468–474; pp. 688–692; Digby's discussion on gravity and the sun is remarkable, while he broke new ground, in particular, as a biologist on embryology, see M. Foster (2009, January 08). Digby, Sir Kenelm (1603–1665), natural philosopher and courtier. *Oxford Dictionary of National Biography*. <https://doi-org.libproxy.helsinki.fi/10.1093/ref:odnb/7629>. The ambivalence of Hartlib towards Digby is notable. Evidently charmed by the Catholic natural philosopher, not the least reason for that being that Digby was 'in very good favour with the lord protector' and that Digby had hired Hartlib's 'chemical son' Clodius in his laboratory, it is plain that it was not appropriate to talk about Digby as one of their own, for instance in his correspondence with Boyle 'Letter Hartlib to Robert Boyle, 8 May 1654' in *The Correspondence of Robert Boyle*, vol. 1 1636–1661, pp. 169–179; Digby is allotted with the 'Cartesians', 'Armiens', 'Calvians' and their failed philosophical and theological discourses, in 'Letter Hartlib to John Worthington 22 February 1659'. See Hartlib Papers, [www.dhi.ac.uk/hartlib/context](http://www.dhi.ac.uk/hartlib/context). See more on the political context of Digby and his endorsing of Blackloism, in Jeffrey R. Collins, 'Thomas Hobbes and the Blackloist Conspiracy of 1649' in 45 *The Historical Journal* (2002), 305–331.

separated humanity from nature.<sup>8</sup> Remien goes on to describe how Boyle employed Digby's *oeconomy* for a different purpose – that of expressing God's governance of the system that the natural world constituted.<sup>9</sup> My reading of Digby differs from Remien's, as I emphasize his project of defending the compatibility of the new science with faith. From within the ranks of mechanical and atomist philosophies, Digby, a prominent biologist in the history of science, wrote in protest against their impending turn to materialism, and hoped to show that the whole *oeconomy* of nature could not be merely a concatenation of material and causal effects, but the work of a designer.<sup>10</sup>

### 6.1.1 *The Last Atom*

The following interpretation offers a fresh context for Boyle's work. I suggest that Boyle's novelty lay not in showing God's sovereignty over the *oeconomy* (something Digby had already done), but in seeking to perfect on an intellectual level Digby's naturalist project by distancing through his use of chemistry the philosophical natural explanations of nature from moral or religious accounts.<sup>11</sup> Furthermore, Boyle did this by using utopian theology as a foundation that would also serve his utilitarian ideas. His atomism required the deconstruction of past knowledge, displacing moral or religious epistemologies about nature – for the goal was to enlarge knowledge – while a theology of abundance sanctioned the extraction of material benefits from the pursue of natural sciences. In more personal

<sup>8</sup> Remien, *The Concept of Nature in Early English Modern Literature*.

<sup>9</sup> Remien explains that Digby had been obscured and dismissed from histories of ecology since he did not fit the main narrative of how ecology developed, summarily, unrelated to mechanical philosophy. Remien, *The Concept of Nature in Early English Modern Literature*, p. 33 and generally ch. 1.

<sup>10</sup> Digby concludes accordingly his first massive treatise on the nature of bodies: 'And when you have once gained thus much of your selfe, to gree unto an orderly course and generation of any single effect; by the power of a material cause working it, raise but your discourse a straine higher, and looke with reverence and duty upon the immensity of that provident Architect, out of whose hands these masterpieces issue, and unto whom it is as easie to make one linke alone: and then you will no longer sticke at allowing the whole *oeconomy* of those actions; to be nothing else, but a production of material effects, by a due ranging and ordering of materiall causes.' See also his nuanced account of the 'vis formatrix', Digby, *Two Treatises*, p. 289; p. 400.

<sup>11</sup> In his unpublished papers, when praising atomism Boyle placed together 'Gassendus, Magnenus (1590–1679, author of Democritus revived or On Atoms, 1646) and Des Cartes' with 'our deservedly famous Countryman Sir Kenelme Digby' see Richard S. Westfall, 'Unpublished Boyle Papers Relating to Scientific Method. II' in *12 Annals of Science* (1957), p. 111.

terms, as a scientist, Boyle appeared fascinated with matter and motion. Moreover, the fact that we know God and discover the composition of the world through matter and motion explains Boyle's adoption of the method of isolating matter through mechanical theory, both philosophically and experimentally.<sup>12</sup>

Thomas Hobbes had noted in *The Elements of Law* that 'every man by natural necessity desireth his own good', and then he went on in *Leviathan* to attribute to each human being in the state of nature a natural right to everything, referring mostly to material goods in nature for which one may need to fight in times of scarcity.<sup>13</sup> Thus arose the struggle characteristic of his state of nature. Boyle's rejoinder to this sociological theory was that the desire for one's good was not merely a 'human thing' or a 'necessity' – that it was God who desired the good(s) and knowledge for human beings, and took care that those who were industrious received them:

For, not content to have provided him all that was requisite either to Support or Accommodate him here, he hath been pleas'd to contrive the World so, that (if Man be not wanting himself) it may afford not onely Necessaries and Delights, but Instructions too.<sup>14</sup>

Nature was thus the solution for humanity, not, as Hobbes had claimed, the problem. In Boyle's normative theory of nature, God the Creator and 'munificent Benefactor', who had endowed the earth richly, was the premise for producing a philosophy of nature. In turn, human beings disappeared from the ambit of the philosophical questions posed by the leading exponent of the new experimental philosophy.<sup>15</sup> Human nature got lost in a theory describing two opposites – the intangible God and a system

<sup>12</sup> 'And, if an Angel himself should work a real change in the nature of a Body, 'tis scarce conceivable to us Men, how he could do it without the assistance of Local Motion; since, if nothing were displac'd or otherwise mov'd than before, (the like hapning also to all external Bodies to which it related,) 'tis hardly conceivable, how it should be in it self other, than just what it was before.' Robert Boyle 'Of the Excellency of Grounds of the Corpuscular or Mechanical Philosophy' in *The Excellency of Theology Compar'd with natural Philosophy* (as both are objects of men's study) (London: Printed. for Henry Herringman, 1674; Early English Books Online Text Creation Partnership, 2011, p. 22, <http://name.umdl.umich.edu/A28966.0001.001>)

<sup>13</sup> Hobbes, *The Elements of Law*, n. 14.12 and chapter 3 of this book.

<sup>14</sup> Robert Boyle, 'Of the Usefulness of Experimentall Philosophy, The First Part, Principally as it Relates to the Mind of Man' in *The Works of Robert Boyle*, vol. 3 (London Pickering and Chatto, 1999), p. 232.

<sup>15</sup> Robert Boyle, 'The Christian Virtuoso: Showing That by Being Addicted to Experimental Philosophy a Man Is Rather Assisted, Than Indisposed to Be a Good Christian', in *The Works of Robert Boyle*, vol. 11, p. 303.

or *oeconomy* of physical nature. We saw in Chapter 2 that the individual remembering the now-disappeared corporeal world in Hobbes's thought experiment of the *annihilatio mundi* was still able to remember its conception of body with some accuracy. Some centuries earlier Avicenna had carried out a similar experiment – about a floating man who does not feel or see the corporeal world but knows that he exists – to affirm the existence of the human soul. In Boyle's experiment of the *annihilatio mundi* only an atom survives:

If we should conceive, that all the rest of the Universe were annihilated, except any of these entire and undivided Corpuscles (...) it is hard to say what could attributed to it, besides Matter, Motion (or Rest,) Bulk, and Shape.<sup>16</sup>

Hobbes had devised a political philosophy for the masses with the tools of his own version of mechanistic natural philosophy. Boyle would in turn produce a popular philosophy of nature with natural laws from which rational human beings were exempt.<sup>17</sup> By means of that philosophy of nature, Boyle, who was at once a forceful and chaotic publicist, also developed economic science or, in other words, principles for making science economically productive for the state, an empire in the making.<sup>18</sup> Michael Hunter noted years ago the danger of taking a narrow approach to the Royal Society's appeal to utility by 'assuming that it referred exclusively to practical, everyday needs'.<sup>19</sup> The breadth and depth of Boyle's thinking helps to overcome this danger, and to ascertain that – strikingly in his case – he was able to be attentive to both grand theory and, to a lesser extent, to daily needs. His economic science is rich, with a background in alchemy, and intriguingly, was destined to establish chemistry as real natural philosophy. At the same time, he articulated his ideas in simple terms destined to reach everyone.

<sup>16</sup> Robert Boyle, *The Origine of Formes and Qualities. According to the Corpuscular Philosophy in The Works of Robert Boyle*, vol. 5, p. 315; p. 317.

<sup>17</sup> That this separation contained the seeds of deism transpires in James E. Force, 'The Newtonians and Deism' in James E. Force and Richard H. Popkin (eds.) *Essays on the Context, Nature and Influence of Isaac Newton's Theology* (Dordrecht, Boston, London: Kluwer Academic Publishing, 1990).

<sup>18</sup> Boyle reflected the difficulties he encountered sometimes with his method of writing composition in sections that with his innovative and all-encompassing inquisitive mind might lead to chaos especially when long periods had elapsed in subsequent revisions, see more about this in Hunter and Davis, 'The Making of Robert Boyle's "Free Enquiry into the Vulgarly Receiv'd Notion of Nature" (1686).

<sup>19</sup> Michael Hunter, *Science and Society in Restoration England* (Cambridge: Cambridge University Press, 1981) p. 89.

Boyle devoted many hundreds of pages to showing the interdependence between the new practical science, the products arriving from the empire and the welfare of the country.<sup>20</sup> Between utopia, represented by theology, and scepticism, presented as natural philosophy, human beings re-emerged in his economic science at once as passive subjects of needs and delights, and as lords of nature, and hence industrious agents of change and transmutation.<sup>21</sup> Knowledge and the exploitation of physical nature thus formed a unity:

And 'tis chiefly by the Knowledge, such as it is, that Experience, (not Art) hath taught Us, of these differing Qualities of Bodies, that we are enabled, by a due application of Agents to Patients, to exercise the little Empire, that we have either Acquired or Regained over the Creatures.<sup>22</sup>

At the same time, consideration of how to multiply the goods of nature and rendering them profitable became a ubiquitous trope in Boyle's studies, published writings and lists of enquiries to fellow scientists and fellow travellers.<sup>23</sup>

### 6.1.2 *The Multiplier*

Multiplication through investment in science was in the air in the seventeenth century, as we saw in Chapter 4. Boyle's closest friends would also use the argument of multiplication to interest him in rather far-fetched economic schemes. When, for instance, his sister, Lady Ranelagh mediated between him and Benjamin Worsley in 1666 to prompt her brother's investment of 500 pounds in a new project, she argued in those terms. This time the business involved the cultivation of senna, herb with medicinal powers that Worsley had received from Barbados and for whose cultivation he wanted to obtain a patent from the King:

<sup>20</sup> Emphasizing the importance of practice for the great thinkers of the Scientific Revolution see, including Boyle, John Henry, *The Scientific Revolution and the Origins of Modern Science*. Third edition (Hampshire, New York: Palgrave, Macmillan, 2008); also noting the experience with products gained through the new great voyages, see R. Hooykaas, 'The Rise of Modern Science: When and Why?' 20 *British Journal for the History of Science* (1987).

<sup>21</sup> That Bacon was also interested in transmutation, in Catherine Wilson, *Epicureanism at the Origins of Modernity* (Oxford: Clarendon Press, 2008), p. 22.

<sup>22</sup> Boyle, *The Origine of Formes and Qualities according to the Corpuscular Philosophy*, p. 298.

<sup>23</sup> Michael Hunter writes that Boyle was in no way ambivalent about the benefits of trade, personally investing large sums in the East India Company, 'enjoying the benefits of trade while professing that his real interest was in scientific inquiry', Hunter, *Boyle: Between God and Science*, p. 169.

I may sudainely be able to give you a particular accoumpt of the course Mr. W. (Worsley) thinks of taking to make his senna presently a Commodety & to Multiplie it to great quantities which appears to me neither disingenuous not unpoliticke.<sup>24</sup>

Boyle's theorization of his ideas on economic science occurred through a series of lengthy writings entitled *Of the Usefulness of Experimentall Natural Philosophy* published over a period of eight years (1663–1671).<sup>25</sup> It was nevertheless a theme that would appear in his writings more generally. *Usefulness* advocated the multiplication of commodified natural goods through two channels: naturalists' activity, experiments, alchemy, the study of mines and so on; and managing trades and labour, the introduction or alteration of crafts, businesses or professions, their change of locality and the introduction of engines in manufacturing processes.<sup>26</sup>

In the second half of the seventeenth century, Boyle and his collaborators raised the status to those practicing experimental science almost to become a social class of its own, as Steven Shapin and Simon Schaffer demonstrated some years ago.<sup>27</sup> Experience of scientific knowledge about nature was to be channelled towards utility for economic and theological purposes. Michael Ben Chaim has shown the ways in which Boyle considered experimental philosophy the paradigm of science at the service of a theology of divine workmanship. Boyle perfected the purification of the Christian religion from the supposedly vulgar metaphysics of the Schools that opened the way both to acknowledgment of God, Creator and Designer and to

<sup>24</sup> 'Lady Ranelagh to Boyle 18. September 1666'; in a previous letter she had explained at length the details, both in *The Correspondence of Robert Boyle*, vol. 3, 1666–1667, p. 239; p. 235. Despite Worsley's and Lady Ranelagh's insistence in their correspondence, the clever Boyle did not seem too convinced of that particular prospect, or at least that it should be carried out of his own pocket.

<sup>25</sup> The series on 'The Usefulness of Experimentall Philosophy' amount to more than 500 pages in total in the modern edition of Boyle's works. The Usefulness of Natural Philosophy I and II Sect. 1, in *The Works of Robert Boyle* vol. 3, pp. 189–561; The Usefulness of Natural Philosophy II, Sect. 2 (1671) *The Works of Robert Boyle* vol. 6, pp. 389–541.

<sup>26</sup> Among his letters there is also an intense correspondence about mines with several persons, which show again how Boyle unites erudite science with economic production. For instance, Samuel Colepresse, a virtuoso who died in 1669, answered a list of eighty-nine queries about mines that he was studying. Judging by his answers, Boyle's queries were, though extremely detailed, mainly about the characteristics of areas where mines with diverse minerals may be found, and about the quantities and processes to yield the minerals, in particular tin and silver. The letter also answers a query about 'fiery meteors', suggesting that Boyle was suspecting the possible relation of the origin of heavy elements such as gold with supernova explosions. 'Colepresse to Boyle. 1 February 1667', in *The Correspondence of Robert Boyle*, v. 3, p. 290.

<sup>27</sup> Shapin and Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life*.



vast knowledge about His Design.<sup>28</sup> Moreover, Boyle was probably propelled into new realms of knowledge by the undeniable nationalism and Independency, both in political and scientific terms, of his millenarian mentors – particularly Benjamin Worsley – who operated outside the strictures of a formal education or school. The development of science, economy and religion were uniquely connected in mid-seventeenth-century, England through Boyle's uncompromising boldness.<sup>29</sup> Certainly, the Reformers of the previous generation were no dilettanti. However, Boyle far outshone them in sophistication – Comenius's basic ideas about a 'professor of necessities' that we saw in Chapter 4 and *Of the Usefulness of Experimentall Natural Philosophy* are worlds apart, in particular due to Boyle's intimate knowledge of the imperial trade – though Comenius is more profound in anthropological terms. As a matter of fact, Boyle became a professional politician of experimental science and sought to advance science and to make it profitable. This trait is visible even in his earliest works and was possibly inherited from his father, the luxury-loving Earl of Cork. It is also to be found in the work of the alchemical authors that inspired him and in that of the Baconian Reformers. In fact, knowledge and profit were the Royal Society's two stated goals and were not merely declared defensively in response to criticism levelled in the 1660s that the Royal Society was made up of gentlemen who killed time by playing with experiments, but as congruent principles within the pragmatist ideas of the period.<sup>30</sup>

Behind Boyle's drive to deconstruct nature, as analysed in Chapter 7, was a thirst for knowledge and scientific curiosity for managing the system or *oeconomy* of nature to the utmost limits, which also ultimately aimed

<sup>28</sup> Ben-Chaim, *Experimental Philosophy and the Birth of Empirical Science*.

<sup>29</sup> John Henry, 'The Scientific Revolution in England', in Roy Porter and Mikuláš Teich (eds.), *The Scientific Revolution in National Context* (Cambridge: Cambridge University Press, 1992), p. 182.

<sup>30</sup> Thus, the Society's historian, Thomas Sprat, wrote that its aims were to produce 'faithful *Records* of all the Works of Nature or Art' and to 'accomplish this, they have indeavor'd, to separate the knowledge of *Nature*, from the colours of *Rhetorick*, the devices of *Fancy*, or the delightful deceit of *Fables*. They have labor'd to enlarge it, from being confin'd to the custody of a few; or from servitude to private interests. They have striven to preserve it from being over-press'd by a confus'd heap of vain, and useless particulars; or from being straitned and bounded too much up by General Doctrines. They have try'd, to put it into a condition of perpetual increasing; by settling an inviolable correspondence between the hand, and the brain. They have studi'd, to make it, not onely an Enterprise of one season, or of some lucky opportunity; but a business of time; a steady, a lasting, a popular, an uninterrupted Work. They have attempted, to free it from the Artifice, and Humors, and Passions of Sects; to render it an Instrument, whereby Mankind may obtain a Dominion over *Things*, and not onely over one anothers *Judgements*. And lastly, they have begun to establish these Reformatations in Philosophy, not so much, by

at imitating God the Creator. Boyle's philosophical effort expressed in his own way the zeal for economic prosperity of the Reformers, who would, as a matter of course, transform that zeal into theology. In the last few decades, important studies have considered Boyle's significance as a natural philosopher. Rose-Mary Sargent and Philip Anstey have rightly recovered from undeserved obscurity the systematic character of a philosophy that appears from the outset wonderfully asystematic. Later thinkers, such as John Locke and Isaac Newton (1643–1727), evidently found inspiration for their own theories in it.<sup>31</sup> As a rule, however, Boyle's ideas on the economics of science are glossed over, which is surprising as they appear to constitute a powerful engine in his theoretical effort. J. R. Jacob famously interpreted Boyle's political programme for atomism as being solely a religious attack against the scholasticism of Jesuits and papists.<sup>32</sup> Boyle's programme does not, however, really justify that characterization when one takes account of the context in which he worked. Catholics, including the French Pierre Gassendi and the English Sir Kenelm Digby, among others, were the most prominent atomists of the period.<sup>33</sup> Moreover, as discussed in Chapter 4, the economic problem was also a *religious* problem.<sup>34</sup>

Recently studies of Boyle have started to highlight the utilitarian aspects of his work not dealt with by previous scholars. For example, Matthew Day

any solemnity of Laws, or ostentation of Ceremonies, as by solid Practice, and examples: not, by a glorious pomp of Words; but by the silent, effectual, and unanswerable Arguments of real Productions.' Thomas Sprat, *The History of the Royal Society for the Improving of Natural Knowledge* (London: Printed for J. Martyn and J. Allestry, 1667), Early English Books Online Text Creation Partnership, 2011, <http://name.umdl.umich.edu/A61158.0001.001> p. 61. Shapin and Schaffer, *Leviathan and the Air-Pump*; Latour, *We Have Never Been Modern*, p. 15. On the critiques, see for instance Margaret Cavendish gendered critique on their 'useless experiments' Lisa T. Sarasohn, 'A Science Turned Upside Down: Feminism and the Natural Philosophy of Margaret Cavendish' 47 *Huntington Library Quarterly* (1984); the satire in plays such as Thomas Shadwell's *The Virtuoso* performed first in 1676, and with success in the next thirty years, where the main role, Sir Nicholas Gimcrack, apparently Boyle, weighed the air for the sake of knowing how much it weighed. Steven Shapin, 'Pump and Circumstance: Robert Boyle's Literary Technology' 14 *Social Studies of Science* (1984), p. 498; p. 517.

<sup>31</sup> Boyle's intense experimental attitude and reticent attitude to draw conclusions had a complex epistemic goal of showing the multiplicity of sources of truth, see about this Rose-Mary Sargent, *The Diffident Naturalist: Robert Boyle and the Philosophy of Experiment* (Chicago: The University of Chicago Press, 1995); Anstey, *The Philosophy of Robert Boyle*.

<sup>32</sup> J. R. Jacob, 'Boyle's Atomism and the Restoration Assault on Pagan Naturalism', 8 *Social Studies on Science* (1978).

<sup>33</sup> Sarasohn, *Gassendi's Ethics*; Digby, *Two Treatises*.

<sup>34</sup> This point was made for instance by Charles Webster in an article suggesting a broad Reformation and Puritan socioeconomic framework of the Scientific Revolution, Charles Webster, 'Puritanism, Separatism and Science', in David C. Lindberg, and Ronald L. Numbers (eds.), *God and Nature. Historical Essays on the Encounter between Christianity and Science*

has noted that the extant textual evidence makes it impossible to argue that Boyle's interest in political economy was comparable with his interest in nature. However, he argues that Boyle was involved in a project of framing economy as technology. Thus, his invention of an instrument to discriminate between real, degraded and counterfeit money amounted to an attempt to eliminate the human dimensions of money.<sup>35</sup> Also Michael Hunter argued not long ago that probably no one wrote more or better than Boyle in his time about the application of science.<sup>36</sup> But on the whole Boyle's huge significance as a philosopher of nature has remained within the confines of what we would call today natural sciences, and not always without controversy.<sup>37</sup> His name is either absent from histories of the birth of seventeenth-century natural law and political economy or used to denote a peripheral figure who conceived corpuscularianism as a sort of conduit between atomism and Aristotelian and Cartesian natural philosophy and inspired others with his tour de force in experimental philosophy. Significantly, he is often linked to William Petty – whose genius was apparent, for instance, in *Political Arithmetic* (1676) – and to John Locke, possibly the natural lawyer of the seventeenth century whose influence remains strongest today.<sup>38</sup> Petty and Boyle's mutual inspiration and

(Berkeley: University of California Press, 1986); it is more generally the argument of his masterpiece, Webster, *The Great Instauration*. With the specific approach of the Calvinist work ethics it was the argument of the classic Max Weber, *The Protestant Ethic and the Spirit of Capitalism*.

<sup>35</sup> Matthew Day 'Restoration Commerce and the Instruments of Trust: Robert Boyle and the Science of Money' 29 *History of the Human Science* (2016), pp. 3–26.

<sup>36</sup> Michael Hunter, 'Boyle on the Application of Science', in Jan-Erik Jones (ed.), *The Bloomsbury Companion to Robert Boyle* (London, New York, Oxford, New Delhi, Sydney: Bloomsbury Academic, 2020).

<sup>37</sup> For instance, as I understood it, the debate between Alan Chalmers and William Newman is partly about the role Boyle played in the Scientific Revolution as a philosopher, where Newman considered that it was crucial, and I tend to agree with him. See for instance, Alan F. Chalmers, 'Boyle and the Origins of Modern Chemistry: Newman Tried in the Fire' 41 *Studies in History and Philosophy of Science* (2010); and the response, William R. Newman, 'How Not to Integrate the History and Philosophy of Science: A Reply to Chalmers' 41 *Studies in History and Philosophy of Science* (2010).

<sup>38</sup> Andrea Finkelstein, *Harmony and the Balance: An Intellectual History of Seventeenth-Century English Economic Thought* (Ann Arbor: University of Michigan Press, 2000); Maifreda, *From Oikonomia to Political Economy*; Akos Silvano, 'The Ontology of Sir William Petty's Political Arithmetic' 26 *The European Journal of the History of Economic Thought* (2019). On the complex question of the Boyle-Locke relationship see Peter R. Anstey, 'Boyle's Influence on Locke', in Jan-Erik Jones (ed.), *The Bloomsbury Companion to Robert Boyle*, p. 48; Ben-Chaim, *Experimental Philosophy and the Birth of Empirical Science*; and adopting a critical standpoint about 'the great influence theory' through a study of Locke's early writings, see Jonathan Craig Walmsley, *John Locke's Natural Philosophy (1632–1671)* (PhD, King's College London, 1998; Reformatted, 2008).

friendship is well known, as is the fact that Locke started work as a theorist around the same time he began to work with Boyle.<sup>39</sup>

'Philosophers', Boyle wrote, 'may have Acquisition of wealth more in their power than in their aim.'<sup>40</sup> However, Boyle's programmatic goal of uniting theology and philosophical knowledge with the goal of making that union useful and profitable is ubiquitous in his work.<sup>41</sup> If his studies had any purpose beyond giving glory to God, generating knowledge and satisfying his prodigious curiosity, it was to achieve 'substantiall Productions to answer the Necessities and Furnish the Accommodations of Humane Life' and to facilitate that the 'artificer learn to make the utmost profit' in order to serve the 'Oeconomical prudence'.<sup>42</sup> In this manner, Boyle's project of knowledge emerges as supported on three pillars: theology, natural science and economy. It is no coincidence that he rectified Bacon's distinction between 'Luciferous' experiments, providing knowledge or light, and 'Fructiferous' experiments, which were to the advantage of one's interests, by coining the term 'Lucriferous' – given that, to the attentive scientist, each implied the other.<sup>43</sup> His statement that the difference between a 'trade' and an 'experiment' lay 'not so much in the Nature of the thing', but in the fact that the former 'had the Luck to be applied to Human Uses, or by a Company of Artificers made their Businesse, in order to their Profit' offers a clue to his way of thinking.<sup>44</sup> Shorn of economic considerations, Boyle's theology and science remain enigmatic and lacking in the extraordinary relevance they appear to have had in the broader social and political context of his time.<sup>45</sup>

### 6.1.3 *Natural Philosophy without Moral Natural Law*

Boyle primarily promoted the study of chemistry, an eminently practical science emerging from alchemy and involved with elements, compounds

<sup>39</sup> In Dublin, Boyle learned from Petty the newest anatomical techniques, for instance, Hunter, *Boyle: Between God and Science*, p. 88.

<sup>40</sup> Robert Boyle, 'Of the Usefulness of Experimentall Philosophy. The Second Part. Of its Usefulness to promote the Empire of Man over things Corporeal, 1663. The First Section of it's Usefulness to physick', in *The Works of Robert Boyle*, vol. 3, p. 296.

<sup>41</sup> 'Man's power over the creatures depends chiefly upon his knowledge' Robert Boyle, 'Of the Usefulness of Experimentall Philosophy. The Second Part. Second Section, in *The Works of Robert Boyle*, vol. 6, p. 436.

<sup>42</sup> Boyle, 'Of the Usefulness of Experimentall Philosophy. The Second Part', p. 394; p. 398.

<sup>43</sup> Boyle, 'Of the Usefulness of Experimentall Philosophy'. The Second Part. Second Section, p. 434.

<sup>44</sup> Boyle, 'Of the Usefulness of Experimentall Philosophy'. The Second Part. Fifth Section, p. 422.

<sup>45</sup> Incidentally, a study assessing how much Adam Smith borrowed from Boyle remains to be done.

and atoms – or corpuscles, as he called them – and this fact is of the utmost importance in this story.<sup>46</sup> A theory of matter is present in his work that entails interconnected – mechanical – elements that comprise a system and possess an intelligence – implying (mechanical) affections. According to Boyle, these attributes undoubtedly come from God and do not call for a theory about human beings or about analogies related to them.<sup>47</sup> William Newman has underlined that the fundamental characteristic of Boyle's atomism is that it was studied from the perspective of a chemist – not from a physicalist – who observes the impossibility of further physical division and evoked images of autonomy and ultimately individualism.<sup>48</sup> More recently, it has been noted by Alexander Wragge-Morley that Boyle imagined God as 'a transcendently skilled chemist'.<sup>49</sup> That was certainly his own model to imitate.

Boyle's investigations are rich and complex, combining Aristotelian ideas of atoms as substances that he borrowed from the German physician Daniel Sennert (1572–1637), only to reject the notion of substance in favour of that of the identity of atoms or corpuscles.<sup>50</sup> Those corpuscles, Boyle emphasized, gained particularity or identity in their interaction with their environment – that is, within the *oeconomy* of nature.<sup>51</sup> This theory is both beautiful and far-reaching but strictly not concerned with human beings, whereas his economics of science employs the same method of ignoring the moral aspect of human agency while focusing on utility. This specific Boylean call would generate dramatic changes in future conceptions of natural philosophy and would emphasize his utilitarian goals. I have little doubt that he was one of the key artificers of the seventeenth-century transformation of natural law. Furthermore, his social importance, the relevance of his philosophical and theological work and his commitment to the discipline of chemistry far removed from human spirit justify the focus on his work in this chapter. Ethics and moral philosophy were of

<sup>46</sup> Lawrence Principe enumerates the central goals of alchemy in the early modern period, that he terms 'its golden age': 'achieving metallic transmutation, producing better medicines, improving and utilizing natural substances, understanding material change', Principe, *The Secrets of Alchemy*, p. 121.

<sup>47</sup> Boyle, *The Origine of Formes and Qualities*, p. 302.

<sup>48</sup> William R. Newman, *Atoms and Alchemy. Chymistry and the Experimental Origins of the Scientific Revolution* (Chicago: The University of Chicago Press, 2006), p. 164.

<sup>49</sup> Wragge-Morley, *Aesthetic Science*, p. 69.

<sup>50</sup> Newman, *Atoms and Alchemy*, pp. 164–189. We will see more about Sennert below; see also Peter R. Anstey, 'Robert Boyle and the Heuristic Value of Mechanism' in 33 *Studies in History and Philosophy of Science* (2002).

<sup>51</sup> Boyle, *The Origine of Formes and Qualities*.

little relevance in the approach he took, which was based on chemical analysis, and in how he thought anew a theology about divine Creation and human beings' dominion over nature (Genesis 1:26–31). Boyle's laws of nature are laws of motion, not moral laws, and the dominion of human beings over nature is about deconstructing and reconstructing nature, traditionally reserved to the omnipotence of God – the Lord of the nature of things – and about extracting economic profit from it.<sup>52</sup>

That was a blend of creationism, science and economy that constituted a fresh start for natural law in lieu of the great ethical contemporary traditions that may be summarized as falling into these four categories: (1) Aristotelian-Thomistic virtue ethics, or a morality of virtues (2) the ethics of the nature of the thing of the modern and late scholastics, expressed either as a morality of precepts or a morality of rights (3) the ethics of needs of the Greek-Arabic medical traditions, or a morality of needs and (4) the Puritan ethics, of a morality of industriousness and utility.<sup>53</sup> Robert Sanderson's seventeenth century casuistic and mechanistic moral philosophy cannot be considered to be in competition with Boyle's ideas, but rather to supplement them. Moral cases concocted with sceptical epistemologies backed by the institutional authority of the Anglican Church completed what experiments could not provide: guidance in respect of individuals' moral behaviour. Thus, the traditional grand moral natural

<sup>52</sup> Transmutation is even denied to Jesus Christ in Aquinas, *Summa theologiae* III, q. 13. a. 2 'But the transmutation of creatures, inasmuch as they may be brought to nothing, corresponds to their creation, whereby they were brought from nothing. And hence even as God alone can create, so, too, He alone can bring creatures to nothing, and He alone upholds them in being, lest they fall back to nothing. And thus it must be said that the soul of Christ had not omnipotence with regard to the transmutation of creatures.'

<sup>53</sup> The following seminal texts can be considered representative of these traditions: Aristotle, *The Nicomachean Ethics*; Aquinas, Thomas, *Summa theologiae*; *Quodlibet* IX, *Henrici de Gandavo, Opera Omnia*, XIII, R. Macken (ed.) (Leuven: Leuven University Press, 1983); *Durandi de Sancto Porciano. Scriptum super IV Libros Sententiarum. Prologus et Distinctiones 1–3 Libri Primi*. Guy Gildentops (ed.) (Leuven: Peeters, 2019); Francisco de Vitoria, *Comentarios a la Secunda secundae de Santo Tomás*, Vicente Beltrán de Heredia (ed.) Vol. III *De Justitia*, qq. 57/66, (Salamanca: Apartado 17, 1934); Hugo Grotius, *The Rights of War and Peace*, with an Introduction by Richard Tuck (ed.) from the Edition by Jeand Barbeyrac (Indianapolis: Liberty Fund, 2005) in 3 vols.; Simon Swain, *Economy, Family, and Society from Rome to Islam: A Critical Edition, English Translation, and Study of Bryson's Management of the Estate* (Cambridge: Cambridge University Press, 2013); *Avicenna Latinus Liber de Anima seu Sextus de Naturalibus IV–V*; Max Weber, *The Protestant Ethic and the Spirit of Capitalism*, Talcott Parsons trans. with an Introduction by Anthony Giddens (London and New York: Routledge Classics, 2001). See also, Terence Irwin, *The Development of Ethics. A Historical and Critical Study. II: From Suárez to Rousseau* (Oxford: Oxford University Press, 2008).

law theories experienced a substantial decline in the face of the underlying normative project of experimental science and of industriously exploiting, enjoying, and investigating nature as the way to God carried out by Boyle and others.

Sorana Corneanu's groundbreaking description of a species of morality that evolved in Europe during the seventeenth century – which she calls 'Regimes of the Mind' – also positions Boyle as legitimizing the experimental line of enquiry against speculative and metaphysical modes of thinking. The method of ascertaining truth through experimental philosophy had both scientific and therapeutic import, and therefore moral value for the mind.<sup>54</sup> However, as Boyle depicted it, the experience of training the mind is remarkably self-centred. It connected, as in a solipsism, the search for supernatural truths with the humility of the industrious scientist. In the absence of a study of human beings, core social and communitarian aspects and rules of morality also disappear.

Therefore, Boyle's emphasis on multiplication, I argue, results from a lack of a solid doctrine of morality in his theoretical work. In the absence of a theory of virtues concerning social life, justice or other invocations of social morality founded on principles of natural law, multiplication and growth become the means of addressing human needs and of satisfying desires. Moreover, an ethics of multiplication placed no limit on the expectations concerning profiting from or exploiting nature by those involved in natural science and trades. Multiplication was at once a scientific method and a source of theological truths about the bountiful Creator by which the contemporary problem of poverty and that of overcoming Hobbes' anthropology of struggle, with its atheist tendencies, could be approached.<sup>55</sup> Boyle employs 'multiplication' as the worldly and social counterpart to the solitary and therapeutic introspection of the individual. Experimental philosophy offered both. He regularly insisted that the love of God manifested itself in the bountiful material goods of nature, the suitability of human bodies to relish them, and the duty of human beings to multiply nature's goods. This theology of abundance was fundamentally alien to the ascetism of the Puritans that Max Weber famously described at the beginning

<sup>54</sup> Corneanu, *Regimens of the Mind*, especially ch. 4.

<sup>55</sup> The poor were not only the vagrant sort of individuals. In the study of political arithmetic (1695) by Gregory King, 'the poorest sort' meant the third class that comprised 51 per cent of the population that had an average income of between six and twenty pounds a year, 'labouring people and outservants', 'cottagers and paupers', 'household of common sea men and soldiers', and around 30,000 vagrants, see for this, Keith Wrightson, *Earthly Necessities, Economic Lives in Early Modern Britain, 1470–1750*, (London: Penguin Books, 2002), p. 449; p. 452.

of the twentieth century.<sup>56</sup> It appears therefore that Boyle's work opened a new avenue for thinking about morality among them. In Boyle's written works only a very narrow set of virtues and desires appear to be relevant for human beings as creatures of God. Boyle has been described as a lay theologian, a description that is also supported statistically since almost half of his numerous texts are religious in nature.<sup>57</sup> When he wrote about natural philosophy and natural sciences, he candidly acknowledged that his aim was not to do theology, and yet his theological arguments often led to one all-encompassing and underlying theme: God has given human beings dominion over bountiful nature and creatures and it is good and right to know, relish, multiply and make them productive.

Boyle was an erudite author, gifted natural philosopher and a man of intense faith with a strong grounding in the Bible and deep scholastic knowledge. While his convoluted prose sometimes makes him appear slightly priggish, he was above all an extremely bold scientist.<sup>58</sup> He would approve of and employ any tools available for the acquisition of knowledge: theology, philosophy, experiments, alchemy, even perhaps private revelation.<sup>59</sup> Ironically, despite being guided in several respects by the supernatural and esoteric, his contribution to natural law represented a novel and intensively desacralized understanding of nature. The ethical significance of *A Free Enquiry into the Vulgarly Receiv'd Notion of Nature* and his devastating critique of the traditional personification of nature that even Reformers such as Jan Comenius rather reaffirmed than destroyed, entailed the disintegration of 'human moral nature' as a concept.<sup>60</sup>

<sup>56</sup> Weber, *The Protestant Ethic and the Spirit of Capitalism*, pp. 102–125; cfr. on Boyle 'Puritanical' attitudes, Henry, 'The Scientific Revolution in England', p. 201.

<sup>57</sup> Edward B. Davis, 'Boyle's Philosophy of Religion' in *The Bloomsbury Companion to Robert Boyle*. A similar *Physico-Theology* by the divine William Derham (1657–1735) in Merchant, *The Death of Nature*, p. 248.

<sup>58</sup> A certain impatience with Boyle's self-righteousness, and perhaps also with the tradition protecting the hero, transpires in the classic Shapin and Schaffer, *Leviathan and the Air-Pump*.

<sup>59</sup> Boyle noted that he did not dare to affirm with the Paracelsians and Helmotians that science may be revealed by angels, but he encouraged to have recourse to the 'Father of lights' (in the plural number) in 'The Usefulness of Natural Philosophy.' in *The Works of Robert Boyle*, vol. 3, p. 276. See for instance, Michael Hunter ed. *Robert Boyle Reconsidered* (Cambridge: Cambridge University Press, 1994); Jan W. Wojcik, *Robert Boyle and the Limits of Reason* (Cambridge: Cambridge University Press, 1997); Lotte Mulligan, 'Robert Boyle, 'The Christian Virtuoso' and the Rhetoric of 'Reason' in Robert Crocker (ed.) *Religion, Reason and Nature in Early Modern Europe* (Dordrecht, Boston, London, Kluwer Academic Publishers, 2001) and Jan-Erik Jones ed. *The Bloomsbury Companion to Robert Boyle*.

<sup>60</sup> Boyle, *A Free Enquiry into the Vulgarly Receiv'd Notion of Nature*, in *Works of Robert Boyle*, vol. 10.



'Nature' was substituted by a new complex system of mechanical forces – an *oeconomy* susceptible to and, in a sense, awaiting the intervention of the chemist. That was the highest expression of the dominion of human beings over natural goods. The *oeconomy* or system of nature constituted Boyle's minimalist metaphysics, which was nevertheless remarkably more rational (and mechanistic) than the millenarian relativism of his friend Benjamin Worsley.<sup>61</sup> Some sort of minimal system beyond the chaos of the Epicureans was necessary in order to make sense of the world.<sup>62</sup> But ideas such as Hobbes's metaphysics of necessity, let alone those of the scholastics, were only barriers to knowledge.

Germano Maifreda's archaeology and Keith Tribe's philological study of the concept of 'economy' in modern Europe help to ascertain how avant garde Boyle's approach was.<sup>63</sup> He abandoned the traditional but narrow understanding of economy as management of the household, even if expanded to the state as advocated by Bodin.<sup>64</sup> The management of nature as a whole ensued. As noted above, Boyle probably borrowed the term *oeconomy*, attributed to nature, from Digby's natural philosophy. However, it was Boyle who first combined three elements: (1) the new epistemological and metaphysical transformation of natural categories (that is, the grouping of the natural world into species etc.), thus diluting Aristotelian substances in his theory of atomism; (2) the socioeconomic purpose of pursuing 'the Empire of Man' in a systematic manner over 'inferior' creatures; and (3) lifting of 'the boundaries of nature', of how natural beings and things are found naturally, in order to multiply its 'productions'.<sup>65</sup> A visionary of the British Empire and beyond, Boyle would identify nature with the physicality of the entire globe. Boyle's economy did address the organization of the management of the world to meet human needs, but it did so with

<sup>61</sup> On the relativism of Worsley see next chapter, and Leng, *Benjamin Worsley (1618–1677) Trade, Interest and the Spirit in Revolutionary England*, p. 190.

<sup>62</sup> A way he had to put this theme was to deny that every matter may be dissolved by fire: 'Why may not Nature associate in divers Bodies the more minute Elementary Corpuscles she has at hand too firmly to let them be separated by the fire?' Robert Boyle, *The Sceptical Chymist*, in *The Works of Robert Boyle*, vol. 2, p. 238.

<sup>63</sup> Maifreda, *From Oikonomia to Political Economy*; Tribe, *The Economy of the Word, Language, History and Economics*, especially ch. 2.

<sup>64</sup> We will see more about this question in Chapter 9. On Bodin and Pseudo-Aristotle *Oeconomia*, see Becker, *Gendering the Renaissance Commonwealth*.

<sup>65</sup> Boyle's philosophical effort is especially novel in Boyle, *The Origine of Formes and Qualities* and Boyle, *A Free Enquiry into the Vulgarly Receiv'd Notion of Nature*.

a breathtakingly global perspective. It had the goal of extracting from, imitating and multiplying productively a system called nature.<sup>66</sup>

My analysis is simple. Boyle's own project of *exaggerating* the economy and resources of nature was not Scriptural. Instead, it grew out of his scientific genius and the economy of the world in which he lived. This included the enjoyment of his immense inherited fortune, a trading and colonial empire in the making, and the urge felt by entrepreneurs or 'projectors', in the parlance of the time, planters and merchants, among others, to make the acquisition of wealth appear respectable. Whether he was personally candid or disingenuous has been much discussed in the literature, for he adopted a low profile and had a modest public persona.<sup>67</sup> However, the authenticity of his deep religious faith cannot be doubted.

His outlook, in common with that of the Reformers, was utopian in combining care for the poor and contemplation of industrious labour, as the path to heaven, with the alluring promise of private richness, evolving autonomously from moral philosophy. The theology of abundance resulted from an independent interpretation of the Bible in accordance with the millenarian tradition of seventeenth-century English Puritans' world view. Their belief in the promise of return to a bountiful Paradise on earth is portrayed in Charles Webster's *The Great Instauration*.<sup>68</sup> Moreover, Boyle displayed a penchant for highlighting the value of pleasure that did not form part of a wider theory of moral philosophy but probably stemmed from his Epicureanism. Boyle was a critical scholar and a stoical experimental scientist, and his alchemical interests only rarely betrayed him; hence, he hardly raised the suspicion of being a charlatan. Moreover, he became a natural scientist due to the knowledge he acquired at an early age as to the increasing possibilities for public wealth offered by the dominions of the British Empire – if they were well managed. His intrepid scientific spirit worked hand in hand with an impatience in relation to finding means of obtaining wealth, which was typical of the alchemists but not unrealistic in his case, except for the fact that he tended to omit the vexing aspects of moral human nature in his theoretical works.<sup>69</sup> After all, human beings had been expelled

<sup>66</sup> On 'imitation' and 'multiplication' of nature, Robert Boyle, 'Of the Usefulness of Experimentall Philosophy. The First Part', p. 212. The notion of system appeared in works on husbandry a bit later, and among the French physiocrats in the next century. Adam Smith flattered himself a century later about his new principles founded on a system of natural liberty, and 'systems of political oeconomy', see Tribe, *The Economy of the Word*, p. 55.

<sup>67</sup> Shapin and Simon Schaffer, *Leviathan and the Air-Pump*.

<sup>68</sup> Webster, *The Great Instauration*.

<sup>69</sup> See on alchemists and money, Wennerlind, 'Credit-Money as the Philosopher's Stone'.

from Paradise for some reason, a Christian belief that he tended to gloss over in his writings. Thus his position was marked by utopian optimism neglecting the dangerous aspects of human beings' nature. Despite his massive theological discourse, the question that Boyle never asks is: will this activity, etc. result in a better, or more righteous individual or a more just society?

## 6.2 The Fact of Man

### 6.2.1 *Voluntarist Law*

In the longer perspective of Boyle's many theological writings, it is perplexing that he eschewed any effort to rationalize the relationship between God and human beings. *The Christian Virtuoso* (1690), his last major work, defined law in moral terms as the positive law that God had explicated to human beings through supernatural Revelation, according to which intelligent and free agents ought to regulate their actions. Differently, inanimate bodies could not restrain, or incite their actions, and they were moved by 'real Power'.<sup>70</sup>

Thus, God's noblest creatures – human beings – had been guaranteed 'an explicit and positive law' that showed them what kind of obedience and worship God expected. Notwithstanding the requirement of obedience to God's law, a human being 'can by reason, without it (Revelation) either not at all, or but rovingly, guess at' the contents of that law. Motivation to comply with divine law thus stemmed less from human conscience than the threat of terrible penalties and the promise of eternal bliss.<sup>71</sup> Boyle denied the Deist view that everything after the formation of the universe was directed by 'the settled laws of nature':

For, beside the insuperable difficulty there is to give an Account of the first formation of things, which many (especially Aristotelian) Deists will not ascribe to God, and besides that the Laws of Motion, without which the present State and Course of things could not be maintain'd, did not necessarily spring from the nature of Matter, but depended upon the Will of the Divine Author of things.<sup>72</sup>

Deists thus disregarded providence, while Boyle considered or did not deny that the laws of motion may originate in the will of God and not

<sup>70</sup> Robert Boyle, 'The Christian Virtuoso', in *The Works of Robert Boyle*, vol. 11, p. 301.

<sup>71</sup> Boyle, 'The Christian Virtuoso', p. 303.

<sup>72</sup> Boyle, 'The Christian Virtuoso', p. 301.

‘necessarily’ in any feature of matter. Non-rational bodies in nature were incapable of understanding or knowing the ‘Will of the Legislator’ and thus of *obeying* any law because, in Boyle’s voluntarist conception of law, such obedience always required a rational and free agent. As he plainly wrote in ‘Free Enquiry into the Vulgarly Receiv’d Notion of Nature’:

But to speak strictly, (as becomes Philosophers in so weighty a matter) to say that the *Nature* of this or that Body, is but *the Law of God prescrib’d to it*, is but an improper and figurative Expression. For, *besides* that this gives us but a very defective *Idea* of *Nature*, since it omits the general Fabrick of the World, and the Contrivances of particular Bodies, which yet are as well necessary as Local Motion itself, to the production of particular *Effects* and *Phaenomena’s*; *besides* this, I say, and other imperfections of this *Notion of Nature*, that I shall not here insist on, I must freely observe, that, to speak properly, a *Law* being but a *Notional Rule of Acting according to the declar’d Will of a Superior*, ‘tis plain, that nothing but an Intellectual Being can be properly capable of receiving and acting by a *Law*.<sup>73</sup>

Logically, therefore, non-rational bodies were ruled out from having any position in a system of (voluntarist) natural laws. Hence the laws of motion were *not properly* laws either, but the result of God’s providential acts of power, and also of divine endowments of power upon His creatures. This was the way in which Boyle combined God’s active involvement (or ‘general concourse’) in the laws of motion with the causal powers of matter in motion to give impulse to further movement in matter.<sup>74</sup> Boyle’s providential and voluntarist theology of power, defending, in relation to moral law, a voluntarist law and an anti-intellectualist position, represented the crowning moment of one of the most successful scientific careers in modern science. Margaret Osler famously attributed Boyle’s ideas to Gassendi’s influence and the latter’s ‘baptism of Epicure’.<sup>75</sup> I hope, however, to show that Boyle’s natural philosophy had

<sup>73</sup> Robert Boyle, ‘Free Enquiry into the Vulgarly Receiv’d Notion of Nature, in *The Works of Robert Boyle*, vol. 10, p. 457 (emphasis Boyle).

<sup>74</sup> More about Boyle’s concept of the laws of nature is discussed below in 7.2.4. Francis Oakley has recently linked this statement of Boyle with Francisco de Suarez’s statement that the term ‘natural law (lex naturae)’ was in relation to physical nature ‘metaphorical since things which lack reason are not capable of obedience’, in *De legibus ac Deo legislatore*, in Francis Oakley, ‘The Rise of the Concept of Laws of Nature Revisited’ in *24 Early Science and Medicine* (2019), p. 23 (Suarez quoted from Oakley’s text). My argument is that Boyle’s complexity reaches beyond the use of metaphors.

<sup>75</sup> Margaret J. Osler, ‘The Intellectual Sources of Robert Boyle’s Philosophy of Nature: Gassendi’s Voluntarism and Boyle’s Physico-Theological Project’, in Richard Kroll, Richard Ashcraft and Peter Zagorin (eds.), *Philosophy, Science, and Religion in England 1640–1700* (Cambridge: Cambridge University Press 1992).

important original aspects based on his own theology and political economy. Sincere and pious thoughts of devotion to God and of the importance of virtue, such as his youthful statement that ‘the Souuerain and greatest Necessity of all (for a man) is to be Vertuus’ abound in Boyle’s writings.<sup>76</sup> These were often coupled with an insistence on the centrality of desires and pleasure, which gives his ideas an aspect of realism that balances his more spiritual utterances. This approach also offers insight not devoid of value against intellectualist positions that seemed to belong to another world.<sup>77</sup> However, since Boyle’s ethical ideas are not unified by an overarching theory of morality and his approach to virtues is not systematic (only some of the virtues are addressed), they often appear unbalanced, reflective of the cultivation of individuality and generally confusing in terms of moral theory. Humility, gratitude, love and trust, delight in abstract truth, docility and openness to veiled truths, modesty of mind, government of reason and, crucially, industriousness are the virtues he mentions repeatedly. However, justice and other social virtues are conspicuously absent from his writings.<sup>78</sup>

But the novelty of Boyle’s work as a natural philosopher lies in the remarkable inattention to human beings evinced by his system of nature. In *The Origine of Formes and Qualities*, probably his most important philosophical piece, Boyle introduced and explained the species of atomism he defended: corpuscularianism.<sup>79</sup> He developed in that text an understanding of nature and nature’s possibilities that was to be put at the service of chemistry and its profitable management. Certainly, human beings were the scientific and economic managers of the new system.<sup>80</sup> In this regard, Peter Remien notes in his ecological study on the concept of nature in early modern literature that Boyle’s ‘anthropocentric teleology’ of the ‘utility of man’ in tension with the welfare of other species would reappear forcefully later in Darwin’s understanding of species as ‘a diffuse set of interconnecting

<sup>76</sup> Robert Boyle ‘The Aretology’, in John T. Harwood (ed.), *The Early Essays and Ethics of Robert Boyle* (Carbondale: Southern Illinois University Press, 1991), p. 39.

<sup>77</sup> On this ‘humane’ aspect of Epicureanism see Wilson, *Epicureanism at the Origins of Modernity*, p. 11.

<sup>78</sup> See the recent overview by Sorana Corneanu, ‘Boyle’s Moral Philosophy’ in *The Bloomsbury Companion to Robert Boyle*.

<sup>79</sup> About how his ideas developed after *The Origine of Formes and Qualities*, see John Henry, ‘Boyle on Cosmical Qualities’, in Michael Hunter (ed.), *Robert Boyle Reconsidered* (Cambridge: Cambridge University Press, 1994).

<sup>80</sup> That Boyle opened the door to a conception of nature by which we ‘directly manipulate the microstructures of things’ with independence of how human beings conceive those bodies is noted in Laura S. Keating, ‘Boyle on Qualities’, in Jan Erik Jones (ed.), *The Bloomsbury Companion to Robert Boyle*, 169–197, p. 192.

centres of interest'.<sup>81</sup> My point here concerns the fact that human epistemology and human nature were not integrated in Boyle's scientific project. Humans stand, as it were, outside nature. Human beings were 'de facto in the world', rational and sensible human beings that perceived the entities in the world in a manner that, in Boyle's view, did not suit the way matter was ordered in reality, i.e. as a combination of atoms.<sup>82</sup> Human beings also had spiritual souls, which also placed them beyond the range of the radar of atomism and consequently of the nature Boyle was studying.

Arguably, a more intense desacralization of non-human nature occurred when the human being was considered separately from nature, and taken to be merely as a *user* of the natural world. The next two sections discuss Boyle's scattered ideas on morality, and Boyle's paradoxical and alternative enchantment/disenchantment with nature.<sup>83</sup>

### 6.2.2 Aretology: *Embracing Human Body*

Boyle chose not to publish his early work *Ethics* or *Aretology* for good reason. This piece, which rather amounts to a compilation of different texts, represents a youthful attempt to write a weighty piece, but falls a little short of succeeding. A mixture of interesting thoughts, borrowings from similar works by other authors, sanctimonious discourse and advice on education (when he started to write it, he was 18 years old!) are united in the 1991 edition of the work. The piece pales in comparison with his more mature works. However, John Harwood is right in noting that Boyle was already a naturalist when he composed the texts.<sup>84</sup> Although he perhaps had not yet

<sup>81</sup> Remien, *Concept of Nature*, pp. 42–46.

<sup>82</sup> 'But now we are to consider, that there are *de facto* in the world certain sensible and rational Beings, that we call Men, and the body of Man having several of its external parts, as the Eye, the Ear, &c. each of a distinct and peculiar Texture, whereby it is capable to receive Impressions from the Bodies about it, and upon that account it is call'd an Organ of Sense, we must consider, I say, that these Sensories may be wrought upon by the Figure, Shape, Motion, and Texture of Bodies without them ... Whence Men have been induc'd to frame a long Catalogue of such Things as, for their relating to our Senses, we call Sensible Qualities; and because we have been conversant with them, before we had the use of Reason, and the Mind of Man is prone to conceive almost every Thing (nay even Privations, as Blindness, Death, &c.) under the notion of a true Entitie or Substance as it self is, we have been from our Infancy apt to imagine, that these Sensible Qualities are Real Beings, in the Objects they denominate.' Boyle, *The Origine of Formes and Qualities* in *The Works of Robert Boyle*, vol. 5, p. 316.

<sup>83</sup> I am borrowing the term from Han van Ruler, 'Minds, Forms, and Spirits: The Nature of Cartesian Disenchantment' 61 *Journal of the History of Ideas*, (2000).

<sup>84</sup> John T. Harwood, 'Introduction' in Harwood ed. *The Early Essays and Ethics of Robert Boyle*.

discovered the delights of experiment, *The Aretology* is valuable in showing how Boyle's thinking on ethics functions in relation to the body, and in particular the *animal* body, and in illuminating his method, which lays the foundations for his later work. The most remarkable aspect of the text is how Boyle combined exalted theological ideas about the happiness in contemplation with a close description of morality as a pathology, or doctrine of affections, and an emphasis on the pleasures of the body.<sup>85</sup> This duality of spirit and body in his exploration of morality and virtue, which is present throughout his works, seems to originate in his scepticism as to the capacity of reason to ascertain truth in practical terms and to recognize natural law, that, as we saw before, he explicitly articulated in *The Christian Virtuoso* near the end of his life. Among many other instances in that text, he referred to notions and principles 'that God hath planted' in the 'Mind of Man' that were 'fit to make him *sensible* that he ought to Adore God'. His was a natural religion lived through 'sentiments' towards 'the transcendent Goodness of God', the 'continual and munificent Benefactor' that would allow human beings to pass 'from Natural to Reveal'd Religion'. The radical spiritual and the sensuous are two extreme and recurrent positions in his works. After all, 'experience', one of his main working concepts, has its origins principally in the senses.<sup>86</sup>

On the other hand, as early as in the *Aretology* Boyle declined to share the spiritualism of radical Puritans who, against all common sense, disregarded the need for, and possibility of, good works on the grounds of justification of believers by faith only. The workings of businesses, life experience, law and punishment, as well as the very nature of free will, attested to the fact that an individual was free and would thus be accordingly virtuous or vicious:

we wil onely heere set down the most Christian and Rationall Opinion:  
which is that tho in Spirituall and Supernaturall Matters, the Will be not  
indifferent to Good and Evill, but (not withstanding its Liberty) cannot but

<sup>85</sup> Without mentioning him, Boyle adopted the theological tradition of Thomas Aquinas in locating happiness in the individual's 'Vision and Fruition' of God. 'Cum ergo ultimus finis quasi exterior humanae voluntatis sit Deus, non potest esse quod aliquis actus voluntatis sit interior finis; sed ille actus erit ultimus finis interior quo primo hoc modo se habebit ad Deum, ut voluntas quietetur in ipso. Haec autem est visio Dei secundum intellectum, quia per hanc fit quasi quidam contactus Dei ad intellectum; cum omne cognitum sit in cognoscere secundum quod cognoscitur; sicut etiam corporalis tactus ad delectabile corporeum inducit quietationem affectus.' Aquinas, *IV Sent.* d. 49, q.1.a.1; Mary Beth Ingham, *La vie de la sagesse: Le Stoïcisme au Moyen Âge* (Fribourg: Academic Press Fribourg, 2007), p. 80; see on 'fruition' also ch. 1, footnote 42.

<sup>86</sup> Boyle, 'The Christian Virtuoso', p. 301; p. 303.

Sin yet in the Exercise of Civill Vertus (and Aeconomically Arts) a man out of his owne Free-will may give himself either to Vertu or Vice, and approve or disapproveth thing proposed, as himself pleases: and by consequent that it is naturally in his Power to be Virtuus or Vitius as himself will.<sup>87</sup>

The dualism is apparent: in spiritual matters the human will 'cannot but sin'. But in real, practical life, Boyle argued in his unpublished work on ethics, the divine determinism typical of radical Puritans was useless. John Henry has argued that the link between the way in which the religious situation evolved in England and the spectacular development of science in the late seventeenth century, often termed the Scientific Revolution, was a theological method translated into natural science. Anglicans, Reformers and Puritans alike, constantly adapting to a middle way between Geneva and Rome, were wary of rationalist reason in theology, had a preference for commonsense reasoning and a commitment to minimalist doctrine. This method, Henry notes, was also employed in natural sciences to ascertain the truth about nature, as facts, without an ideological bias.<sup>88</sup> This picture fits some aspects of Boyle, who, exactly as Henry describes, took distance from both Puritan and Hobbesian ideas of corrupted human nature when discoursing about 'civil life' and opted, with English common sense, for a middle way of personal virtue. He thus rejected both 'Aristotelicians' who, in not allowing 'the Cherishing of passions so far as to enable them to discompose the mind' lead people away from virtue, and 'Stoicks' who would have the 'wise man' settled 'in that Immoveable Constancy, that no impulsions of the Sensitive Appetite should be able to make wander from the dictates of Reason'. Passions were good for many reasons that Boyle listed in *Aretology*, and renouncing them stemmed from and evidenced the 'Blockish stupidity of the Stoicks'.<sup>89</sup>

However, Boyle went further than this and was novel in certain respects. Probably influenced by French moralists, he celebrated a human nature created by God for delights, even though he lacked, as stated above, a serious theological anthropology. His fearlessness about the consequences of that deficiency may be perhaps attributed to satisfaction with his own

<sup>87</sup> Boyle, 'The Aretology', p. 43.

<sup>88</sup> Henry, 'The Scientific Revolution in England'; and Henry, 'Sir Kenelm Digby, Recusant Philosopher'.

<sup>89</sup> Where Aristotle would argue in favour of tempering the passions and the Stoics in favour of a life 'Without Passions', Boyle wrote that 'the Wise man' was 'Above them'. Boyle 'The Aretology', p. 18.



version of right reason. In the context of the evolution of English views of right reason – as described in Chapter 5, and for instance expressed by John Spurr and Robert A. Greene – which faintly preserved some sort of illumination of principles of natural law in the capacity of reasoning, Boyle's understanding of right reason is perplexing, distinctive and novel.<sup>90</sup> Sorana Corneanu has contributed greatly to illuminating Boyle's approach. As she explains, Boyle's right reason belongs neither to a tradition of illumination nor to principles of natural law. However, it is a moral conception, for it concerns the mastering of the passions and ordering of intellect and governing the mind through virtuous inquiry (of empirical, Baconian influence), possessing the interesting goal of 'growing' in (natural) knowledge.<sup>91</sup> This idea is discussed further in the last two sections, but it is worth noting at this juncture that Boyle regarded also quantity as crucial in this area.<sup>92</sup>

Also, religious axioms guided Boyle's work, which places him outside the seventeenth-century trends of waning of the religion's role in relation to doing science. It is more accurate to describe it as a straightforward example of the relatively recent separation between the realms of science and religion – in this case, moral laws being removed from the realm of natural philosophy – discussed by Peter Harrison.<sup>93</sup> Some contemporary authors had sought to integrate with creativity the array of main philosophical and theological foundations in the idea of moral reason, which also connects with the political principles of absolutism. Thus the light of nature had an extraordinary burden of tasks to perform in *The Darknes of Atheism Dispelled by the Light of Nature: A Physico-Theological Treatise* by the physician Walter Charleton (1619–1707), a friend of Hobbes and Lady Margaret Cavendish and translator of Epicure. He described the light of nature as a 'Domestick oracle' and 'the Magna charta of all temporal knowledge', and in fact understood it as offering instruction

<sup>90</sup> John Spurr, "Rational Religion" in Restoration England' 49 *Journal of the History of Ideas* 563–585 (1988); Greene, 'Synderesis, the Spark of Conscience, in the English Renaissance'.

<sup>91</sup> Corneanu, *Regimens of the Mind*, generally ch. 4 and p. 128.

<sup>92</sup> See further on Boyle's description of the 'abstracted reason' that reach few of the 'Multitude of things knowable' opposed to the experience and revelation, Corneanu, *Regimens of the Mind*, p. 133.

<sup>93</sup> Peter Harrison, *The Territories of Science and Religion* (Chicago: The University of Chicago Press, 2015); also a critique to a once hegemonic distinction between religion and science in the historiography of the Scientific Revolution, in Alexander Wragge-Morley, *Aesthetic Science: Representing Nature in the Royal Society of London, 1650–1720* (Chicago: The University of Chicago Press, 2020).

about truth.<sup>94</sup> However, in respect of practical deliberation concerning moral action, Charleton referred also to an *indifference* both of will and of intellect (towards good or evil) on the basis of the experience of how inconstant and changing was an individual's judgment about things. He illustrated his explanation of probabilities in respect of moral judgment by reference to scales. 'Below uncontrollable Necessity', rational judgment would not be absolutely indifferent, but experience or reasons would usually tip the scale in one direction or another, thus recognizing the good to be chosen.<sup>95</sup> Similarly to Hobbes's determinism, Charleton argued as follows:

That every man, in whom the *Light of Nature* is not damp't by *Fatuity*, either native and temperamental, or casually supervenient, hath this or *impress* of an *especial Providence*, decreeing and disposing all events, that have, do, or shall befall him.<sup>96</sup>

The light of nature became thus an 'intestine Dictator'.<sup>97</sup> Robert Sanderson's efforts to construct a mechanical conscience, as discussed in Chapter 5, are indicative of the daunting challenge involved in producing a working concept of practical reason and conscience during that period. Ultimately, Boyle's decision not to make moral philosophy part of his project of knowledge is captured in his statement in the *Aretology* that 'knowledge of Ethicks, though helpful, was not absolutely necessary'.<sup>98</sup> Bypassing the middle ground of theories about the truth of practical reason or of moral natural law, he devoted his energies to the experimental sciences and his scientific interest remained constraint to physical body. Nevertheless, he took the view that his investigations into matter offered enough material for those searching for divine things. What he called 'Inferior sort of truths' might lead directly to 'Divine truth' and at the same time dispose the mind towards the habit of searching for truth.<sup>99</sup>

<sup>94</sup> Walter Charleton, *The Darknes of Atheism Dispelled by the Light of Nature: A Physico-Theological Treatise* (London: Printed for William Lee, 1652), Early English Books Online Text Creation Partnership, 2011, <http://name.umdl.umich.edu/A69728.0001.001>, p. 15; p. 41.

<sup>95</sup> Charleton, *The Darknes of Atheism Dispelled by the Light of Nature*, p. 271.

<sup>96</sup> Charleton, *The Darknes of Atheism Dispelled by the Light of Nature*, p. 170. Charleton's praises Hobbes for having proved the natural immortality of human soul in *Leviathan*, p. 90. Lisa Walters 'Epicurus and Gender in the British Newcastle Circle: Charleton, Hobbes and Margaret Cavendish' in Lisa Hopkins and Tom Rutter (eds.) *A Companion to the Cavendishes* (York: Arc-Humanities Press, 2020).

<sup>97</sup> Charleton, *The Darknes of Atheism Dispelled by the Light of Nature*, 170; Eric Lewis, 'Walter Charleton and Early Modern Eclecticism' 62 *Journal of the History of Ideas* (2001).

<sup>98</sup> Boyle 'The Aretology', p. 54.

<sup>99</sup> Boyle, 'The Christian Virtuoso', p. 304.

In conclusion Boyle's *Aretology* is indicative of the fact that from an early age he was too much of a student of the human body, and a naturalist – and one probably under the influence of Gassendi and perhaps Aquinas too – to neglect pleasure or desire. Gassendi's doctrine of a moral psychology, structured by seeking pleasure and avoiding pain may have inspired him more than anything else: hence his apology for Epicure at the beginning of the text, which is similar to the one he inserted in *The Usefulness*.<sup>100</sup> Examples of and comparisons between human beings and how wolves, sheep and dogs act figured prominently in Boyle's rather biological ethics in some parts of *Aretology*.<sup>101</sup> Affections, he wrote, were so natural to 'man' that 'he can as soone devest himself of being an animal, as exempt himself of the Commotions of his Appetites'. Beyond that and, not without some shade of unreality, he also noted that animals were usually content 'to Satisfy nature', whereas human beings' passions were literally inexhaustible: 'once overflown the Bankes of Reason' they 'ar like a Fire blowne up by the Feuel of their Enjoyments into a greater Flame'. However, Boyle was not a whole-hearted Gassendist. Dmitri Levitin has also recently interpreted Boyle as increasingly rejecting the dogmatic reductionism of Epicurean atomism.<sup>102</sup> Although observance of the fact of 'unlimited desires' of human beings keeps cropping up in his economic writings, in terms of theory, he seems to have approached the issue of morality from the other end: the animal body. But when dealing with the theme of the usefulness of science, Boyle milked the question of human beings' unlimited desires for utilitarian purposes.

The question arises as to how he reconciled the economic promotion of the satisfaction of manifold and inexhaustible desires with his earnest entreaties to engage in contemplation and to have faith? How can godly piety triumph over hedonism if, as we will see below, science ought to serve economy through the promotion of unlimited pleasures? Boyle's written works do not acknowledge any conflict between these two positions, and his repeated and ambiguous utterances with regard to Epicureanism, together with the fact that he set aside moral

<sup>100</sup> Osler, 'The Intellectual Sources of Robert Boyle's Philosophy of Nature'; on Gassendi's ethics, see Sarasohn, *Gassendi's Ethics: Freedom in a Mechanistic Universe*; Boyle, 'Of the Usefulness of Experimentall Philosophy', p. 237. In the past century Robert Kargon denied originality to Boyle who would have been simply introducing Gassendi's Epicureanism in England, Robert Kargon, 'Robert Boyle, and the Acceptance of Epicurean Atomism in England' 55 *Isis* (1964).

<sup>101</sup> Boyle 'The Aretology', p. 13; 16; p. 17; p. 51; p 76.

<sup>102</sup> Levitin, *Ancient History in the Age of the New Science*, pp. 707–711.

philosophy for good, make his work difficult to critique from this angle.<sup>103</sup> Boyle's focus on hedonism largely resulted from his reluctance to delve into the complexities of human nature and his refusal to become a moral philosopher – as Gassendi was and John Locke would become – while amplifying human desires in his project for the utility of science.

### 6.3 The Grand Business of Nature

Utilitarian ideas as to the use of nature had appeared in different ways, sometimes in a subtle manner, often quite explicitly in the work of renowned Catholic theologians of the sixteenth century, such as Francisco de Vitoria.<sup>104</sup> In analysing the question of dominion as 'use', Vitoria elaborated on a common theme for Parisian theologians, at least after the early fourteenth century – the enjoyment of 'the tree of life' for the benefit of human beings.<sup>105</sup> Vitoria commented that God's prohibition on eating from another tree, 'the Tree of Paradise' could be interpreted as a negation of the idea that human beings were true lords of the Earth. Instead, he argued, human dominion over goods was complete, despite the limitations that God had set in respect of that tree. In view of the specific definition of 'dominion as a right to use' – i.e. dominion divided into a bundle of rights – the prohibition concerning 'the Tree of Paradise' posed no difficulties. The Bible made it clear that God had prohibited human beings from *eating* from the tree. However, eating was only one of the possible uses that it offered. Human beings 'could benefit from that tree through other uses, thus, to give the brutes of its fruits or to cut branches

<sup>103</sup> The ambiguity about one's position towards Epicureanism seemed common, for instance, Samuel Parker (1640–1688) hid his own influences of Gassendi-Epicurean materialism by pointing to the arrogance of Epicure and Descartes alike in claiming to know what the soul was, Levitin, *Ancient Wisdom in the Age of the New Science*, p. 666. On Parker see, Jon Parkin, "Parker, Samuel (1640–1688), bishop of Oxford." *Oxford Dictionary of National Biography*. September 23, 2004. See also, Wilson, *Epicureanism at the Origins of Modernity*.

<sup>104</sup> On the utilitarianism of Vitoria see Mónica García-Salmones Rovira, 'Francisco de Vitoria on the Theology of Dominion and Secular Natural Rights', in José Maria Beneyto (ed.), *Empire, Humanism and Rights* (Cham: Springer, 2022); Campagna, *Francisco de Vitoria: Leben und Werk*, p. 75.

<sup>105</sup> Providing e.g. in Durandus de Saint Pourçain, pure and strengthening food that facilitated immortality, *Durandi a Sancto Porciano, Ord. Praed. et Meldensis Episcopi, In Petri Lombardi Sententias Theologicas Commentariorum libri IIII, Venetiis, MDLXXI. Ex Typographia Guerræa*. (Republished: Ridgewood, New Jersey, The Gregg Press Incorporated, 1964), lib. 2 d. 19 q. 1.

off it for his or her uses or for other uses'.<sup>106</sup> In short, the tree had multiple uses, some of which were allowed to human beings while others were not. Vitoria's conclusion was that God gave human beings dominion over all things, notwithstanding the fact that he excluded some uses from that dominion. Because *dominium* signified a right to use, the prohibition of some uses did not hamper humanity's dominion over all the goods of the earth.<sup>107</sup> The entitlement to use also entailed the important conclusion that human beings could employ the goods of creation 'not for all, but only for the licit uses'.<sup>108</sup>

### 6.3.1 Aquinas's Theology of Use

There is little doubt that Thomas Aquinas's theology was a *theology of use*, by which I mean a method of thinking about problems relating to the science of God in which a free agent, a human being, is thought to be acting, rightly or wrongly upon a reality that has been given or presented to her. At the deepest anthropological level, the 'good' of human beings is described in the *Summa theologiae* as the use with a good will of anything in the world – a world in which God also participates.<sup>109</sup> Hence, 'the good of human beings, absolutely considered, is a good operation viz. the good use of things that are possessed'; the ultimate good to be possessed being, of course, God. In opposition to that, 'sin' amounts to the bad use

<sup>106</sup> 'Dubium aliud est de ligno paradisi: quomodo homo est dominus illius postquam vetitum est ei? Ergo aliquid Deus servavit sibi cuius non dedit homini dominium. Concedo. Parum est hoc quod aliquid sit cuius non dedit Deus homini dominium, postquam dedit multorum aliorum dominium. Vel dico quod etiam dedit ei dominium illius ligni, quia solum ei prohibuit ne comederet de illo. Poterat tamen uti eo ligno ad alios usus, scilicet ut daret brutis poma illius, vel excindere ramam illius ad usus suos, vel ad aliud; et hoc non prohibuit Deus. Sed solum ne comederet de illo. Ita quod homo non erat dominus omnium rerum ad omnes usus utamur illo, sicut ne dominus est dominus servi ad omnes usus, quia non ad occidendum. Et sic Deus communicavit homini dominium rerum, licet aliqui usus illarum sint excepti. Et sic propositio nostra generaliter sumpta est vera, quia homo habet dominium omnium rerum.' de Vitoria, *Comentarios a la Secunda secundae de Santo Tomás*, q. LXII, art. 1, p. 73.

<sup>107</sup> See on the notion of dominion in Francisco de Vitoria, Brett, *Liberty, Right and Nature*, ch. 4 and generally.

<sup>108</sup> de Vitoria, *Comentarios a la Secunda secundae de Santo Tomás*, q. LXII, art. 1, p. 69; p. 73.

<sup>109</sup> A good will is the will acting in accordance with reason, since 'reason is the cause and root of the good of human beings.' *Summa theologiae*, I. II, q.66 a.1.co; I.II, q. 18, a. 5 and I.II, q. 61, a. 2. I am mainly employing Alfred J. Freddoso's translation, in combination with the Latin original at the Corpus Thomisticum project, and also making small changes in it myself. New English Translation of St. Thomas Aquina's *Summa Theologiae* by Alfred J. Freddoso, [www3.nd.edu/~afreddos/summa-translation/TOC.htm](http://www3.nd.edu/~afreddos/summa-translation/TOC.htm).

of things.<sup>110</sup> In response to the question of whether happiness may lie in riches, Aquinas answered that happiness lies neither in natural nor in artificial riches. The reasoning behind this conclusion is that natural riches simply sustain the lives of human beings, and surely happiness should be based on something more than that which achieves physical survival. On the other hand, Aquinas held that artificial riches were ‘for the sake of natural riches, since they would not be sought except that things necessary for the sustenance of life (*necessariae ad usum vitae*) are bought with them’.<sup>111</sup>

Therefore, artificial riches had even less the character of an ultimate end, since their meaning merely reinforced that of natural riches in making possible human beings’ use of the gift of life.

Aquinas defined virtue as good use of free will (*bonus usus libero arbitrio*).<sup>112</sup> Furthermore, in the *Prima Secundae*, he described how the virtuous act of choosing was done either with regard to human acts or to doing or using things (*facere re or uti re*).<sup>113</sup> In respect of doing things, Aquinas gave the example of the physician whose aim is to promote health; while in respect of using things, he gave the example of a greedy human being whose aim is to acquire money. He also defined pleasure as either ‘knowing’ only or ‘knowing that one possesses certain things’ such as honour or fame. The pleasure that accompanies the possession of things arises from the fact of ‘making use of them or being able to make use of them’.<sup>114</sup>

Coming closer to the topic of nature Aquinas also argued that in Paradise animals were inferior to human beings in terms of use, government and characteristics. In the order of nature superior beings use and govern inferior beings. The reason for human beings’ superiority was that only they possessed universally the virtue of prudence, while certain other

<sup>110</sup> Aquinas was explaining why sin has more the character of evil than punishment. *Summa theologiae*, I pars, 48.a 6. co.

<sup>111</sup> *Summa theologiae* I,II, q.2.a.1.co.

<sup>112</sup> *Summa theologiae*, I,II, q.55.a.1 ad.2.

<sup>113</sup> *Summa theologiae*, I,II, q. 13. a. 4. co.

<sup>114</sup> ‘Reply to objection 1: The objects of the operations are themselves pleasurable only insofar as they are joined to us either (a) through cognition alone, as when we take pleasure in thinking about or looking at certain things, or (b) in some other way along with cognition, as when one takes pleasure in knowing that he possesses some good, such as riches or honor, etc., that is pleasurable only if it is apprehended as possessed. For as the Philosopher says in Politics 2, “To think of something as one’s own is a great pleasure that proceeds from the natural love one has for himself.” For having things of this sort is nothing other than making use of them or being able to make use of them, and this occurs through an operation. Hence, it is clear that every pleasure is traced back to an operation that is a cause of it.’ *Summa theologiae* I,II, q.32.a.1.ad.1

animals have it to a limited extent.<sup>115</sup> Finally, in the well-known passage on the use of natural goods in the section devoted to the sins against justice, *Summa theologia* q. 66 a.1. co, in response to the question of whether the use of goods was natural to human beings Aquinas famously answered:

- I respond: There are two possible ways to think about an exterior thing:
- (a) with respect to the nature of the thing, which is not subject to human power, but only to the power of God, whom all things obey at will;
  - (b) with respect to the use of the very thing – and in this sense a human being has natural dominion over exterior things, since by his reason and will he can make use of exterior things for his own utility as almost things made for his sake.

Human dominion over nature was therefore limited to the use of goods for their utility while human beings lacked the power over the configuration of ‘the nature of the thing’ that only God possessed. However, since human beings are endowed with reason, their dominion was not merely physical, like that of lower animals, but also involved a type of dominion over certain creatures:

For as was established above [q. 64, a. 1], things that are less perfect or less complete exist for the sake of things that are more perfect or more complete. And this is the line of reasoning by which the Philosopher proves in *Politics* I that the possession of exterior things is natural to human being. Now this natural dominion over other creatures that belongs to human being in accord with his reason, in which the image of God consists, is made manifest in the very creation of man in Genesis 1, where it says, “Let us make man to our likeness and image and set him above the fish of the sea, etc.

God the Creator was therefore, according to Aquinas, the sovereign with absolute power over the design of the Creation – a power which human beings did not enjoy. In his answer to the first objection, Aquinas made a distinction in relation to the concept of ‘dominion’. ‘God’ had ‘the principal dominion (*principale dominium*) over all things’. It was a result of God’s providence that certain things were ordered towards the bodily sustenance of human beings. This meant that human beings had ‘a natural dominion over things as regards the power to use them (*ad potestatem utendi ipsis*)’. Aquinas therefore viewed human beings’ ‘natural dominium’ as ‘a power to use’. Their ‘natural dominion’ amounted to ‘use’.<sup>116</sup>

<sup>115</sup> *Summa theologia*, I. q. 96. a.1.co; *Summa theologiae*, I-II. q.1 a1.co ‘Differt autem homo ab aliis irrationalibus creaturis in hoc, quod est suorum actuum dominus.’

<sup>116</sup> *Summa theologiae*, II-IIae q. 66, a. 1. ad 1. ‘Ad primum ergo dicendum quod Deus habet principale dominium omnium rerum. Et ipse secundum suam providentiam ordinavit

In response to the second objection, as to justice – the statement in the New Testament (Luke 12:18) that ‘the rich man is reprimanded’ and that accordingly material, exterior goods are unnatural for human beings – Aquinas explained that the rich man’s error was to think that the exterior goods were principally his own, in the sense that he had not received them from another (i.e. from God).<sup>117</sup> In response to the third objection – Ambrosius’s statement that human beings ‘cannot transform nature’ – Aquinas replied that this argument was only about a dominion over things as regards ‘their natures’, which, as he had noted, belonged to God alone.

The fact that ‘use’ had such an important role in Aquinas’s theology about human beings in relation to nature derives from the supposition that human beings are free moral agents in a created world who act upon spirit and matter. Moreover, in order to have power, which may be Aquinas’s fundamental category in respect of human beings, there has to be something towards which the exercise of that power or dominion aims, apart from oneself.<sup>118</sup> As Stathis Psillos has put it, in Aquinas’s work powers are both innate qualities and exist in relation to something else, there is a purpose to them.<sup>119</sup> Human beings use their ‘will’ and ‘reason’ in the same way that they use ‘money’ or ‘food’. The use of the material world, ‘reason’ or ‘will’ could be good and then they led to God or, in the opposite case, to evil.

### 6.3.2 *Knowing the Bountiful Nature*

Boyle’s utopian theology furnishes what I have referred to above as the ‘multiplier’, i.e. his project of turning science into a real agent of the economy. This comprised, first, an anthropology of unlimited desires that resulted in a perhaps not eternal but definitively exponential increase in consumption of divinely designed, inexhaustible and, to that point, mostly unknown natural resources that were hidden in the bowels of the earth,

res quasdam ad corporalem hominis sustentationem. Et propter hoc homo habet naturale rerum dominium quantum ad potestatem utendi ipsis.’

<sup>117</sup> However, it is noticeable that following the mendicant tradition, in the *Summa tertia pars* when he discussed the perfections of Jesus as an individual man, Aquinas noted that ‘condemning all riches’ Jesus showed the highest degree of liberality and magnificence, while he exercised liberality giving ‘to the poor what was given to Himself.’ Aquinas, *Summa theologiae*, III, q.7, a. 2, 3co.

<sup>118</sup> This is visible in the *Summa*, but specially in Aquinas, *Quaestiones Disputatae de Potentia Dei*; Riccardo Saccenti, *Debating Medieval Natural Law: A Survey* (Notre Dame: University of Notre Dame Press, 2017), p. 77.

<sup>119</sup> Stathis Psillos, ‘The Inherence and Directedness of Power’ in *Reconsidering Causal Powers: Historical and Conceptual Perspectives*, p. 58.



situated in faraway and exotic territories or within potential or invisible (atomic) mixtures. Second, the multiplier emerges in the improvement of production through the multiplication of trades, by which Boyle appears to have meant the specialization and refinement of works, crafts and techniques that he saw taking place around him and that would greatly increase production. Scientists were crucial in improving knowledge of the products of nature, developing new working techniques and acting as mediators of knowledge between economic actors. Scientists like Boyle began the study of political economy in the modern sense of concentrating on the usefulness of (natural) objects for economic production.<sup>120</sup> This, I argue, is Boyle's paradigm shift.

His most characteristic stance appeared in the seminal *Of the Study of the Booke of Nature* of around 1650 in which he wrote that 'God created the World for a Double End', being 'the manifestation of his owne Glory' and 'the Good of Men, principally of the Elect'.<sup>121</sup> But he was also specific in repeatedly stating his position in respect of a qualified utilitarianism of creation as universal knowledge:

tho' I judge it erroneous to say in the strictest sense, that every thing in the Visible World was made for the Use of Man; yet I think'tis more erroneous to deny, that any thing was made for ends Investigable by Man.<sup>122</sup>

Utopian theology also comprised the complex vocation of 'priest', 'natural scientist' and citizen of the British Empire that Boyle himself seemed to embody. With regard to the rest of inanimate and irrational creatures unable to acknowledge how much they owe their Creator, 'Man' he wrote in the *Of the Usefulness of Experimentall Natural Philosophy* was 'born the Priest of Nature'; by investigating nature, God received glory. To praise God was human beings' 'natural right'.<sup>123</sup> Not only did pleasures abound in the world, but also knowledge, which implied industriousness,

<sup>120</sup> Karl Marx mocked in a footnote to the first chapter of *The Capital* the 'fictio juris' in 'bourgeois societies' that 'everyone as a buyer possesses an encyclopedic knowledge of commodities.' Instead, Marx argued in the bulk of the text: 'The use values of commodities furnish the material for a special study, that of the commercial knowledge of commodities.', which is exactly what Boyle proposed, Marx, *The Capital*, p. 27; p. 53.

<sup>121</sup> Robert Boyle, 'Of the Study of the Booke of Nature' in *The Works of Robert Boyle*, vol. 13, pp. 147–172, p. 149. The idea is repeated in Boyle, 'Of the Usefulness of Experimentall Philosophy, The First Part', in *The Works of Robert Boyle*, vol. 3, p. 217.

<sup>122</sup> Boyle, 'A Disquisition about the Final Causes of Natural Things, in *The Works of Robert Boyle*, vol. 11, p. 87; p. 95.

<sup>123</sup> Boyle, 'Of the Usefulness of Experimentall Philosophy, The First Part', in *The Works of Robert Boyle*, vol. 3, p. 238.

even perhaps martyrdom. Similarly to the ancient right to priesthood among the Jews, so 'Reason' was 'a Natural Dignity' and 'Knowledge a Prerogative' that could 'confer a Priesthood without Unction or Imposition of Hands'.<sup>124</sup> The world was a 'sacrament' (*Verbum visibile*) – a visible sign of God.<sup>125</sup> Boyle's beautiful and groundbreaking stance is clear here. That was a very concrete means of praising God that went beyond specialized circles of *virtuosi* and was being proposed, in fact, to anyone who cared about natural sciences and the Empire. However, he was also breaking with theological tradition in two ways. As it classically considered that inanimate and irrational creatures praised God just by the fact of *being*; secondly, without a theory of morality, the danger of utopian pragmatism in Boyle's proposal loomed large. Around the years he wrote *The Usefulness* Boyle became a member of the Council for Foreign Plantations (1660–1664) and was appointed to the committees of Jamaica and New England, and it is not unreasonable to think that his new situation as a civil servant put Boyle's rare imagination to work.<sup>126</sup>

Few other modern English writers were more sophisticated than Boyle in combining natural philosophy, faith and economy. Intimations about the expansion of the empire underlined his image of the 'World' as a 'Ship'.<sup>127</sup> Such metaphors, of which he used plenty, adapted the traditional theological metaphors on the economy of salvation to the exigencies of the British Empire.<sup>128</sup> The world, he argued, was not merely an 'Inne', as the divines noted, with the idea that life is a journey and Christians found in the world every refreshment in the manner of a traveller who finds a place

<sup>124</sup> He gave the example of 'the Elder Pliny' for his curiosity in watching how the Vesuvius erupted as 'a martyr of Physiologie. For we daily see Alchymists hazard their Lives on Minerall Experiments in Furnaces'. Boyle, 'Of the Usefulness of Experimentall Philosophy' in *The Works of Robert Boyle*, vol. 3, p. 201; quote in p. 203.

<sup>125</sup> Boyle, 'Of the Usefulness of Experimentall Philosophy, The First Part', in *The Works of Robert Boyle*, vol. 3 p. 232; p. 238.

<sup>126</sup> See also how important was for Boyle his careful use of rhetoric and other means of communication: 'metaphors were to the mind what microscopes were to the eye', in John T. Harwood, 'Science Writing and Writing Science: Boyle and Rhetorical Theory', in Michael Hunter (ed.), *Robert Boyle Reconsidered* (Cambridge: Cambridge University Press, 1994), p. 51; and John T. Harwood, 'Introduction', in John T. Harwood (ed.), *The Early Essays and Ethics of Robert Boyle* (Southern Illinois University Press, 1991), i-lxix. See also Hunter, *Boyle: Between God and Science*, p. 110.

<sup>127</sup> Boyle, 'Of the Usefulness of Experimentall Philosophy, The First Part', in *The Works of Robert Boyle*, vol. 3, p. 218.

<sup>128</sup> For the economic metaphors more generally in the Christian theological tradition see, Giacomo Todeschini, "Quantum Valet? Alle origini di un'economia della povertà," 98 *Buletino Dell'istituto Storico Italiano per Il Medio Evo e Archivio Muratoriano* (1992).

to stop. The world indeed offered everything ‘to feed Man and delight him’. However, references to the ‘Inne’ suggested interruption of one’s journey, whereas the image of ‘the Ship’ gave the impression of the traveller being helped ‘to convey him towards his Journey’s end’. Moreover, the image of the ship illuminated the fact that God had created nature, not only for Christians’ satisfaction, but also for their instruction. On this point, Boyle employed another metaphor – that of God as a benevolent donor, who would not withdraw from human beings’ knowledge concerning his endowment. It would be irreverent to assume that God ‘sends them to Sea disprovided of *Sea-Charts* and *Mariners Compass*, and other requisite helps to steer their Course by, to the desired Harbour’.<sup>129</sup> An elaboration of the older and remarkable paragraph of *Of the Study of the Book of Nature* that was mentioned in Chapter 4 appears in *The Usefulness of (Experimentall) Naturall Philosophy*.<sup>130</sup> It summarizes Boyle’s ideas with regard to theological principles about the design of God in the creation of nature and of human beings and about a realist emphasis on body. As mentioned, the work contains no reflection on possible moral tensions arising in relation to the fulfilment of unlimited desires, but merely enthusiasm for their multiplying effect in terms of consumption, industriousness and knowledge. The passage merits being quoted at length:

And ‘twas perhaps, *Pyrophilus*, to ingage us to an industrious indagation of the Creatures, that God made Man so indigent, and furnish’d him with such a multiplicity of Desires; so that whereas other Creatures are content with those few obvious and easily attainable necessaries, that Nature has every where provided for them; In Man alone, every sense has a store of greedy Appetites, for the most part of Superfluities and Dainties, that to relieve his numerous Wants, or satisfie his more numerous Desires, He might be oblig’d with and inquisitive Industry to Range, Anatomize, and Ransack Nature, and by that concern’d survey come to a more exquisite Admiration of the Omniscient Author. To illustrate this subject yet a little further, *Pyrophilus*, give me leave to observe to you, That Philosophers of almost all Religion have been, by the contemplation of the World, mov’d to consider it under the notion of a Temple.<sup>131</sup>

<sup>129</sup> ‘A wise Merchant, that sends Persons, he loves, to a farre Country, to think that he would furnish their Cabinets with Plenty of Provision, soft Beds, fine Pictures, and all other accommodations for their Voyage’, Boyle, ‘Of the Usefulness of Experimentall Philosophy, The First Part’, in *The Works of Robert Boyle*, vol. 3, p. 218.

<sup>130</sup> See the chronological table of writings in The Robert Boyle Project, Birkbeck, University of London: [www.bbk.ac.uk/boyle/media/pdf/Boyles-writings-chronological.pdf](http://www.bbk.ac.uk/boyle/media/pdf/Boyles-writings-chronological.pdf)

<sup>131</sup> Boyle, ‘The Usefulness of Natural Philosophy’, in *The Works of Robert Boyle*, vol. 3, p. 237. Despite his utilitarian views Boyle wrote an early unpublished text (1647–1648) in which he condemns purposeless cruelty with creatures, and states that God created ‘them for other

The Epicurean tone of praising desires is habitual in Boyle's work – he never appears austere or abstemious, and certainly not Puritan, rather touching on the merry aspect of Creation. Particularly in *The Usefulness*, in which this paragraph appears, Boyle observed the 'indigence' of human beings and their inclination to satisfy not only necessities but multifold and unlimited desires. In the context of the project of applying science, unlimited human desires become a manifestation, even an *opportunity*, to relish the bounty of the Creator, and not a negative tendency. Moreover, many of Boyle's theological, philosophical and metaphysical convictions are disclosed gradually in that important text of *The Usefulness*. Boyle explained his apologetic style by stating that he was addressing it to some religious people, afraid that the scientific knowledge of nature would shake belief. On the contrary, he argued, explaining that observation of God's 'Workmanship' in nature was one of the main methods for strengthening faith. Accepting his own explanation, and as mentioned before, Boyle's insistence on the usefulness of science has been in the literature partly attributed to critiques concerning irreligiosity and impractical activities carried out by the Royal Society.<sup>132</sup> However, the text is much more than a pious exercise of apology. At once a normative programme and a manifesto for scientists, Boyle brings out the big guns within the text in the form of the economic possibilities hidden in nature and in natural science. On the other hand, in the second part, which deals with 'Physick' (medicine) and the amelioration of medicinal remedies, the discourse is about 'necessity' and the economic aspect recedes from view almost completely, save that the importance of providing cheaper remedies for the poor is mentioned.<sup>133</sup> The economic discourse returns in the lengthy second part of Section II, which is devoted to proving the usefulness of natural philosophy in contributing to the profitability of trades.

Ends, besides Man's Service & Advantages.' Malcolm Osler comments the text in the context of animal experiments increasingly practiced by the members of the Royal Society, including Boyle. Malcolm R. Oster, 'The "Beame of Divinity": Animal Suffering in the Early Thought of Robert Boyle' 22 *The British Journal for the History of Science*, (1989), p. 175.

<sup>132</sup> Hunter, *Boyle: Between God and Science*; Sprat, *The History of the Royal Society for the Improving of Natural Knowledge*, p. 61. Shapin and Schaffer, *Leviathan and the Air-Pump*; Latour, *We Have Never Been Modern*, 15–18; Sarasohn, 'A Science Turned Upside Down'; Shapin, 'Pump and Circumstance: Robert Boyle's Literary Technology', p. 498; p. 517.

<sup>133</sup> Noting that it was important to investigate cheap remedies; some 'cannot imagine that what doth not cost much Money in the Shops, can do much good in the Body; as if God had made Provision onely for the Rich, or those People that have Commerce with China or the India's.' Boyle, 'Of the Usefulness of Experimentall Philosophy. The Second Part' in *The Works of Robert Boyle*, vol. 3, p. 382.

With their capacity for pleasure and for praising the Almighty in the creatures human beings were singled out from the rest. Moreover, since human beings were the only ones capable of ‘enjoy, use and relish’ the rest of the beings, living and inanimate, the latter had been made for the former, not for God, not for themselves:

For it is no great presumption to conceive, that the rest of the Creatures were made for Man, since He alone of the Visible World is able to enjoy, use, and relish many of the other Creatures, and to discern the Omniscience, Almightynesse and Goodnesse of their Author in them, and returne Him praises for them.<sup>134</sup>

The ‘necessaries of life’ were abundantly provided in nature for every creature. However, the other animals were *limited* to ‘necessaries’, whereas all the material goods in the entire Creation were at the disposal of human beings:

The Earth produces him an innumerable multitude of Beasts to feed, cloath, and carrie him; of Flowers and Jewels to delight and adorne him; of Fruits to sustaine and refresh him; of Stones and Timber, to lodg him; of Simples, to cure him; and in Summe, the whole sublunary World is but his Magazine. And it seems the grand businesse of restlesse Nature so to constitute and manage his Productions, as to furnish him with Necessaries, Accommodations and Pleasures.<sup>135</sup>

More than anything desires were the means decreed by God to prevent human beings’ passivity towards nature and promote their (intellectual) industriousness. In the first three essays contained in *Of the Usefulness of Experimentall Natural Philosophy*, Boyle urges the argument that the industrious study of nature was a source of power, riches and faith – industriousness and its variants is probably the most repeated word in the text. Natural philosophy ‘is not only Delightful, as it teaches us to Know Nature, but also as it teaches us in many Cases to Master and Command her’.<sup>136</sup> The possibilities that studying nature gave to the naturalist to imitate, multiply and improve its wonderful phenomena was in a sense the ‘Empire of Man, as a Naturalist over the Creatures’. It consisted in ‘a much more satisfactory kind of Power or Sovereignty’ than the most common

<sup>134</sup> Boyle, ‘Of the Usefulness of Experimentall Philosophy’ in *The Works of Robert Boyle*, vol. 3, p. 216.

<sup>135</sup> Boyle, ‘Of the Usefulness of Experimentall Philosophy’ in *The Works of Robert Boyle*, vol. 3, p. 229.

<sup>136</sup> Boyle, ‘Of the Usefulness of Experimentall Philosophy’ in *The Works of Robert Boyle*, vol. 3, p. 211.

forms of political sovereignty. The latter was often the consequence of ambition, bloody struggles, crime or even simply chance. The former, Boyle argued, was innocent.<sup>137</sup>

### 6.3.3 *Technology from the Plantations*

Boyle's most remarkable employment of economic ideas appeared in the third part of *Of the Usefulness of Experimentall Natural Philosophy*, in which he was already thinking in terms of industrial manufacture. His distinction between bare necessities and what may now be termed luxuries was again introduced. 'It is not only to the Trades that minister to the necessities of Mankind' he noted 'but to those also that serve for man's accommodation and delight, that Experimentall philosophie may bring Improvements', including, 'perfums', 'making seweet-meats', embellishing 'the Face with cosmeticks, and divers others of the like voluptuous nature'.<sup>138</sup> Boyle's innovation here lay not so much in his proposal for the improvement of crafts but in his ability to mediate between all economic positions involved as a spokesman for science.<sup>139</sup> In this process it was essential that artisans trusted the natural scientists. If 'tradesmen' were to disclose some of their experiments to 'practicall Naturalists', Boyle argued, 'the difussed knowledge and sagacity of Philosophers' would be able to improve them markedly.<sup>140</sup>

Furthermore, his narration of how a combination of *transplanting* commodities<sup>141</sup> to which improved techniques were applied, with the result of multiplying the employment of workers ('mechanical hands') reveals him as something akin to a seer in respect of the future Industrial Revolution. Firstly, importing and exporting commodities would also bring about the idea of the multiplying effect. For foreign natural goods were sometimes more productive, such as the wonderful exuberance of the Indian corn or

<sup>137</sup> Boyle, 'Of the Usefulness of Experimentall Philosophy' in *The Works of Robert Boyle*, vol. 3, p. 212.

<sup>138</sup> Boyle, 'Of the Usefulness of Experimentall Philosophy' in *The Works of Robert Boyle*, vol. 3, p. 417.

<sup>139</sup> That Boyle was not especially original in this particular idea of improving the crafts for economic benefit may be seen from Vera Keller, 'Scarlet Letters: Sir Theodore de Mayerne and the Early Stuart Color World in the Royal Society', in Vera Keller, Anna Marie Roos, and Elizabeth Yale (eds.), *Archival Afterlives. Life, Death, and Knowledge-Making in Early Modern British Scientific and Medical Archives*, (Leiden, Boston: Brill 2018).

<sup>140</sup> Boyle, 'Of the Usefulness of Experimentall Philosophy' in *The Works of Robert Boyle*, vol. 3, p. 399.

<sup>141</sup> Boyle, 'Of the Usefulness of Experimentall Philosophy. Second Part. Second Section', 412.

the Chinese rice. Moreover, exploiting new ideas had a direct impact in augmenting production, and thus profit:

For these Inventions of ingenious heads doe, when once grown into request, set many Mechanical hands a worke, and supply Tradesmen with new meanes of setting a livelihood or even enriching themselves.<sup>142</sup>

It is important to emphasize Boyle's originality here in noting the possibilities of profit for the entrepreneur in allegiance with 'science'. In studies of the cultural roots of the Industrial Revolution, reducing labour costs through mechanization in order to gain profit for the entrepreneur is considered to be the vital insight, in contradistinction to the public policy mantra of putting the poor to work. However, this principle is situated much later in time, around the mid-eighteenth century.<sup>143</sup> But Boyle's advice for combining new technologies with an increase in 'mechanical hands' to the trader or owner of a manufactory in the widely read *Of the Usefulness of Experimentall Natural Philosophy*, as 'more advantagious to him' was given a century earlier. Sometimes Boyle urged the employment of more chemical processes, where mechanic devices were common. In cases where no technology was applied, he noted again with his futuristic emphasis in multiplication that things 'that ought to be done mechanically' still undertaken 'by the labour of the Hand, may with far more ease and Expedition (the quantity considered) be performed by Engines'.<sup>144</sup>

Boyle's own notorious report of 'a recent Instance of the transplanting of Arts and Manufactures' may conclude this section. He recalls how a foreigner travelling from Brazil to Europe with some sugar canes happened to stop in Barbados, and there 'an English Planter that was curious' obtained not only some sugar canes from him but also 'some Hints of the way of cultivating and using them'.<sup>145</sup> The importance of the story was for him that 'the Introduction of one Physico-Mechanical Art' may put many hands to work. Without offering further detail, he added that

<sup>142</sup> Boyle, 'Of the Usefulness of Experimentall Philosophy' in *The Works of Robert Boyle*, vol. 3, p. 399.

<sup>143</sup> Margaret C. Jacobs points to a text of mechanics of 1744 by Newton's assistant, John Teophilus Desaguliers (1683–1744) as the first with that 'critical insight' in Margaret C. Jacob, 'The Cultural Origins of the First Industrial Revolution' in Marcus Hellyer (ed.), *The Scientific Revolution: The Essential Readings* (Oxford: Blackwell Publishing, 2003), p. 212.

<sup>144</sup> Boyle, 'Of the Usefulness of Experimentall Philosophy' in *The Works of Robert Boyle*, vol. 3, p. 478.

<sup>145</sup> Boyle, 'Of the Usefulness of Experimentall Philosophy' in *The Works of Robert Boyle*, vol. 3, p. 424.

'I had the particular opportunity to learn by Enquiry, that ... the Blacks, living as Slaves upon that spot of the Ground, and imploy'd almost to tally about the planting of Sugar, amount at least to between five and twenty, and twenty thousand persons'. He also gave some figures to show 'how Lucriferosus in that place this so recent Art of making Sugar is, not onely to private man, but to the publick'.<sup>146</sup> Boyle's conclusion was, in his own words, '*That the Experimentall philosopher may not only Improve Trades, but multiply them*' (emphasis by Boyle).<sup>147</sup>

Two things are noticeable in this narration. Boyle was thinking in this case of a lucrative endeavour for private individuals and the public – in sum, for the economy of the empire as a whole. Moreover, his exposition of the conditions of labour of the slaves in Barbados seems to suggest that he not only approved of them but wanted to see them adopted in his own country. Workers in England ought to be employed as the slaves were employed already in the Plantations – this is what his suggestions as to importing the labour techniques used in Barbados appears to suggest. The 'mechanical art' applied to slaves' work in the plantations would equally make trades and manufacturers in England more profitable, which, with hindsight, would appear to make the slaves on the plantations the unwilling initiators of the English Industrial Revolution.

Boyle's mention of the mechanical arts used in Barbados refers to a manufacturing process used in sugar mills involving advanced chemical and mechanical technologies that raised sugar production and consumption in England to much higher levels than had previously been the case.<sup>148</sup> Eric Otremba describes how the English scientific community attributed the success of sugar-making in Barbados to the *ingenios*, a type of furnace

<sup>146</sup> Though 'scarcely credible', he had obtained the following numbers from one of the ancient Magistrates of the Island of Barbados. This amounted to shipping off to England 'ten thousand Tun', each tone 'two thousand Pund weight of sugar' which amounted to 'twenty millions of Pounds of that Commodity'. Boyle, 'Of the Usefulness of Experimentall Philosophy' in *The Works of Robert Boyle*, vol. 3, p. 425.

<sup>147</sup> Boyle, 'Of the Usefulness of Experimentall Philosophy' in *The Works of Robert Boyle*, vol. 3, p. 425. As noted before, Robert Boyle used this word to emphasize the union between light or knowledge and profit, that had been distinguished by Bacon as 'luciferous' versus 'fructiferous' experiments, Peter R. Anstey, 'Philosophy of Experiment in Early Modern England: The Case of Bacon, Boyle and Hooke' in 19 *Early Science and Medicine* (2014), p. 111.

<sup>148</sup> 'In turning the pith of the sugar cane plant into white crystalline sucrose, the ingenios of the Atlantic basin relied upon a series of mechanical and chemical processes which were highly sophisticated for their day' Eric Otremba, 'Inventing Ingenios: Experimental Philosophy and the Secret Sugar-makers of the Seventeenth-Century Atlantic' 28 *History and Technology* (2012), p. 122.



or mill for processing sugar cane, and to the clever plantation owners who ran them. However, this view neglected the contribution of the sugar-making know-how possessed by slaves and servants, which, as Otremba argues, was ultimately the critical factor in the entire enterprise.<sup>149</sup> Richard Ligon's well-known *A True and Exact History of the Island of Barbados* (1657) both describes and sketches the *ingenio* in detail and gives a very melancholy account of the conditions of life and work of the European servants and slaves involved in operating it. He thereby informed the English and European public of both the incredible possibilities offered by the island and of the conditions under which these possibilities were being exploited. Both African slaves and Christian servants, who were of Irish extraction or European captives of war, were 'commodities': the former were owned by the plant owners for life, the latter for five years. Ligon emphasized the terrible heat common in the island for eight months of the year, under which the thousands of servile workers laboured for ten hours a day in the field. Then there was the *ingenios* furnace to contend with. Some masters were good, some not. Ligon's narration makes clear that under these conditions slaves often committed suicide or ran away.<sup>150</sup> Boyle had read Ligon's history of Barbados thoroughly and made numerous annotations.<sup>151</sup> To see him engrossed in the technological and horticultural detail of the natural history of the 'ingenious Ligon' but apparently unengaged by the sociological aspects of the narrative casts his remarks on the virtues of Barbados's 'mechanical hands' in a sombre light.

I contend that his declaration of the usefulness of the scheme while remaining silent on the conditions of labour results directly from Boyle's glossing over human nature in the context of his studies of nature. That would evolve into the tragic side of the Scientific Revolution. The European practice of slavery was almost two centuries old by that point,

<sup>149</sup> Otremba, 'Inventing Ingenios'. More generally, that 'the practick part' contained much knowledge not easily transferable was however soon realized by the fellows of the Royal Society, despite their early confidence on the force of intellect and deriding comments of ignorant and 'rude mechanics' Michael Hunter, *Science and Society in Restoration England* (Cambridge: Cambridge University Press, 1981), p. 104.

<sup>150</sup> This information in Richard Ligon, *A True and Exact History of the Island of Barbados* (London: Humphrey Moseley, London, 1657) Early English Books Online Text Creation Partnership, 2011 <http://name.umdl.umich.edu/A48447.0001.001>

<sup>151</sup> Describing Boyle's method of annotations his notes on Ligon's *A True and Exact History of the Island of Barbados* are mentioned in Jordan Avramov and Michael Hunter, 'Reading by Proxy: The Case of Robert Boyle (1627–1691)' 25 *Intellectual History Review* (2014), p. 42. Boyle also mentions the 'Ingenious Mr. Lygon' about a fruit in the Caribbean in *The Origine of Formes and Qualities*.

with the Spanish Empire's requirements for workers promoting the horrific business, but without offering any justification for it. This only happened when utilitarian ideology gained ground among European philosophers. In her study on the justifications of slavery through political economy Anne Charlotte Martineau explains how around sixty years later the physiocrat François Melon (1675–1738) pointed out in an *Essai politique sur le commerce* (1734) that the significance of slavery lay in its 'utility' rather than whether it was contrary to morality or religion.<sup>152</sup>

Therefore, the salient issue is not how far Boyle was prepared to go in order to defend his project of useful experimental science, but rather to observe how soon a utility-oriented science that made no attempt to incorporate the moral nature of human beings within its epistemic realm would render compromises with matters contrary to fundamental morality and prejudicial to human beings unavoidable – even in the hands of its best practitioners. As a consequence of the utilitarianism human beings become the exploitators of nature, instead of their guardians, as well as utilitarianism's victims. The utilitarian lack of moral anthropology in science, which place human beings outside nature, leaves nature and human nature unprotected on the face of future utilitarian schemes.

<sup>152</sup> See about this, Anne-Charlotte Martineau, 'Comment et pourquoi écrire l'histoire du droit international? Le cas de l'abolition de l'esclavage' 18 *Clio@Themis* (2020), pp. 1–15, p. 14.