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William Paley Confronts Erasmus Darwin: Natural Theology and Evolutionism in the Eighteenth Century

This article examines the relations between natural theology and evolutionary theories in the eighteenth century, and in particular William Paley's response to the Zoonomia of Erasmus Darwin. It discusses the status of the argument from design, and suggests that in eighteenth century Britain the argument became less prominent after about 1730 when the threat of atheism, as distinct from deism, was felt to have receded. Paley should be seen as successfully reviving and updating natural theology to counter new philosophical and scientific threats, and in particular Erasmus Darwin's evolutionary theory, the first to give a systematic account of biological adaptation. In his response Paley showed the inadequacy of any theory that explains adaptation by the active exertions of organisms. The article concludes with suggestions for further study of Paley's influence in the nineteenth century.

Key words: Natural theology; evolution; argument from design; William Paley; Erasmus Darwin.

Introduction

The admiration of the young Charles Darwin for the theological works of William Paley¹ is well known. He later considered the study of Paley to have been the only useful part of his formal education at Cambridge, recalling that he had been 'charmed and convinced' by Paley's arguments, which gave him 'as much delight as did Euclid'.² *Of the Natural Theology* in particular he wrote, with more enthusiasm than grammar, 'I do not think I hardly ever admired a book more than Paley's *Natural Theology*. I could almost formerly have said it by heart.'³

1 The main works of William Paley (1743–1805) are *Principles of Moral and Political Philosophy* (1785); *Horae Paulinae* (1790); *Evidences of Christianity* (1794); and *Natural Theology* (1802). The primary sources for Paley's life are Meadley, G. W., *Memoirs of William Paley*, Sunderland, (1809); Edmund Paley's introduction (Gregg Reprint edn., Farnborough (1970) to his edition of his father's works; and Best, H. D. *Personal and Literary Memorials* (1829). A short recent biography is Clarke, M. L. *Paley: Evidences for the Man*, London: SCPK (1974), while the fullest study of Paley's work is Le Mahieu, D. *The Mind of William Paley: A Philosopher and his Age*, Lincoln, Nebraska: University of Nebraska Press (1976).

2 Barlow, N. (ed.) *The Autobiography of Charles Darwin, 1809–1882*, London: Collins (1958), p. 59.

3 Letter of 22 November 1859 from Charles Darwin to John Lubbock, in Burkhardt, F. and Smith, S. (eds.) *The Correspondence of Charles Darwin*, Vol 7, 1858–1859, Cambridge: Cambridge U. P. (1991), p. 388.

It may be more surprising that Paley has admirers among biologists today. George C. Williams, one of the most influential of modern evolutionary theorists, cites the *Natural Theology* as 'worth close attention by all biologists',⁴ while Richard Dawkins declares it 'a book that I greatly admire'.⁵ These scientists value in Paley the clarity and force with which he sets out the evidence for *adaptation* in the organic world. The Darwinian theory of evolution by natural selection claims to solve the problem of adaptation without recourse to a Creator, yet Paley's work, on this view, remains unsurpassed as a statement of the problem. In recognition of this, Dawkins has half-seriously suggested the label 'transformed Paleyists' for those who share his own adaptationist outlook.⁶

Darwin himself may plausibly be seen as a 'transformed Paleyist' in these terms. Indeed, long ago C. C. Gillispie noted that 'in one sense Darwinism is Paleyism inverted'.⁷ Similar views on the importance of Paley's thought to Darwin have become widely accepted.⁸ It is therefore surprising that fuller attention has not been paid to one striking feature of the *Natural Theology*, namely, that it contains a powerful, sustained, and cogent attack on the emerging evolutionary speculations of his time. Specifically, Paley attacks what he describes as 'the system of appetencies': the theory that organisms have acquired their present structure and faculties by long-continued efforts to satisfy their needs or 'appetencies'. His critique gains added piquancy from the fact that its main target is unmistakably the speculations of Charles Darwin's grandfather.

I do not suggest that this aspect of the *Natural Theology* has been wholly overlooked. It has been widely, if sporadically, recognised in the literature on Charles Darwin,⁹ on Erasmus Darwin,¹⁰ and on Paley himself.¹¹ But these

4 Williams, G. C. *Natural Selection: Domains, Levels, and Challenges*, New York: Oxford U. P. (1992), p. 190; see also the same writer's *Adaptation and Natural Selection*, Princeton, NJ: Princeton U. P. (1966), p. 259.

5 Dawkins, R. *The Blind Watchmaker*, London: Longman (1986), p. 4; the title of Dawkins's book is of course itself an allusion to Paley's 'watchmaker' analogy.

6 Dawkins, R. 'Universal Darwinism', in Bendall, D. S. (ed.), *Evolution from Molecules to Men*, Cambridge: Cambridge U. P. (1983), p. 404.

7 Gillispie, C. C. *Genesis and Geology*, New York: Harper (1959) [originally Harvard U.P. (1951)], p. 219.

8 For example, by Cannon, W. F. 'The bases of Darwin's achievement: a reevaluation', *Victorian Studies*, (1961), 5, 109-34; Limoges, C. *La Selection Naturelle*, Paris: Presses Universitaires de France (1970), p. 42; and Young, R. M. *Darwin's Metaphor: Nature's Place in Victorian Culture*, Cambridge: Cambridge U. P. (1985), pp. 31, 39, 97. Any brief formula such as 'Paleyism inverted' is of course a simplification of Darwin's position: for fuller discussions see Brooke, J. H., 'The relations between Darwin's science and his religion', in Durant, J. (ed.) *Darwinism and Divinity*, Oxford: Blackwell, (1985), pp. 40-75; and Kohn, D., 'Darwin's ambiguity: the secularization of biological meaning', *Brit. J. Hist. Sci.*, (1989), 22, 215-39.

9 Examples include Cannon, op. cit. (8); Hodge, M. 'Darwin as a lifelong generation theorist' in Kohn, D. (ed.), *The Darwinian Heritage*, Princeton: Princeton U. P. (1985), p. 211; and Bowler, P. *Charles Darwin*, Oxford: Blackwell (1990), p. 27.

10 See McNeil, M. *Under the Banner of Science: Erasmus Darwin and his Age*, Manchester: Manchester U. P. (1987), pp. 89-90; and Porter, R. 'Erasmus Darwin: doctor of evolution?' in Moore, J. (ed.), *History, Humanity and Evolution: Essays for John C. Greene*, Cambridge: Cambridge U. P. (1989), p. 59. Richards, R. J. *Darwin and the Emergence of Evolutionary Theories of Mind and*

discussions have been brief, and in my view have not done justice to Paley's arguments.

The present article provides a fuller analysis of Paley's reaction to the evolutionary speculations of his time. Beyond that I hope to contribute something to the wider re-evaluation of natural theology and its interplay with science. Few historians now assume that science and religion are inevitably in conflict.¹² Nevertheless, prejudices linger. In particular, few take seriously the force of the argument from design: the thesis, central to Paley's *Natural Theology*, that the existence of a deity can be inferred from the order, beauty, or utility found in nature.¹³ In the view of many the argument was deeply flawed from the outset. The fallacies, so the story goes, were definitively exposed in Hume's great *Dialogues Concerning Natural Religion*. We might charitably excuse those who accepted the argument before Hume's critique was published, but those who, like Paley, expounded it thereafter must be convicted of ignorance, incompetence, or intellectual dishonesty.¹⁴

I hope to show that this line of thought exaggerates the force of Hume's attack, and that Paley dealt effectively with the latest philosophical and scientific challenges. But first it may be helpful to outline the status of the argument from design in the eighteenth century, the objections it faced, and the threat presented by the first coherent theory of evolution.

The Argument From Design in the Eighteenth Century

The argument from design—henceforth for brevity 'the Argument'—is among the oldest themes in philosophy.¹⁵ In antiquity the Argument was developed

10 (Contd) *Behavior*, Chicago: University of Chicago Press (1987), p. 128, has noted that Paley also attacks Erasmus Darwin's associationist theory of animal instinct; unfortunately to explore this aspect of Paley's critique here would greatly extend the scope of this article.

11 See Clarke, M. L. *op. cit.* (1), pp. 96–7; Le Mahieu, D. *op. cit.* (1), pp. 70–71, for a fuller discussion, which however does not identify Erasmus Darwin as the target; and Yeo, R. 'The principle of plenitude and natural theology in nineteenth-century Britain', *Brit. J. Hist. Sci.*, (1986) 19, 263–282, who thinks it 'likely' that Paley had Erasmus Darwin in mind.

12 For recent historical surveys of the relationship between science and religion see especially Brooke, J. H. *Science and Religion: some Historical Perspectives*, Cambridge: Cambridge U. P. (1991), and Lindberg, D. C. and Numbers, R. L. (eds.) *God and Nature: Historical Essays on the Encounter between Christianity and Science*, Berkeley: University of California Press (1986).

13 In referring to the argument from design I do not mean to deny the variety of different forms of the argument, some of which are discussed further below.

14 For representative examples, see Kemp Smith, N., *Hume's Dialogues on Natural Religion*, Oxford: Oxford U. P. (1935), p. 38; Hurlbutt, R. R. *Hume, Newton and the Design Argument*, Lincoln, Nebraska: University of Nebraska Press (1965), p. 168; and Reardon, B. M. J. *From Coleridge to Gore: a Century of Religious Thought in Britain*, London: Longman (1971), p. 4. Paley himself comes in for some abusive language: thus Hurlbutt, *op. cit.*, p. 171, describes him as 'a particularly thick-headed man', while Reardon, *op. cit.*, p. 4, opines that the *Natural Theology* is 'clearly not the work of a philosopher'.

15 I am not aware of any comprehensive historical treatment of the Argument. For general orientation I have found the works of Brooke (12) and Hurlbutt (14) most useful; see also Glacken, C. J., *Traces on the Rhodian Shore*, Berkeley: University of California Press (1967) and Emerton, N. 'The argument from design in early modern natural theology', *Science and Christian Belief*, (1989), 1, 129–147.

most fully by the Stoic school, against the doctrine of their Epicurean atomist rivals that the world was formed by chance.¹⁶ The arguments presented by the rival schools, as recorded in Cicero's dialogue *De Natura Deorum*, were cited constantly down to the eighteenth century and beyond.¹⁷ The history of the Argument will be fundamentally misunderstood if the persistence of the opposition between Epicurean and Stoic teachings is overlooked.

By the common consent of historians the golden age of the Argument came towards the end of the seventeenth century and the beginning of the eighteenth, coinciding with an upsurge of anxiety at the spread of religious scepticism and outright atheism.¹⁸ An important feature of this period is the revitalization of the Argument by new scientific knowledge, creating the genre known as physico-theology.¹⁹ In Britain alone more than a dozen major works deployed the latest scientific findings in proof of God's existence, culminating in the encyclopaedic treatises of Ray and Derham.²⁰ The alliance between science and religion had advantages for both sides. By defending religion the exponents of the new scientific philosophy helped avoid the suspicion of infidelity; an especially pressing motive for advocates of atomism, with its Epicurean associations. At the same time religion gained a new and seemingly inexhaustible source of support. Never since antiquity had the Argument had such authoritative exponents.

It is commonly supposed that the physico-theological tradition began earlier, survived later, and was generally stronger in Britain than elsewhere.²¹ I wish to suggest one caveat and one correction to this view. The caveat is that the British tradition has been more closely studied than that of other countries,²²

16 For the Argument in the ancient world generally see Pease, A. S. 'Caeli Enarrant', *Harvard Theological Review*, (1941), 34, 163–200 and Gerson, L. P. *God and Greek Philosophy: Studies in the Early History of Natural Theology*, London: Routledge (1990).

17 Cicero, *The Nature of the Gods*, tr. H. C. P. McGregor, Harmondsworth: Penguin (1972).

18 For natural theology in this period see especially Westfall, R. S. *Science and Religion in Seventeenth-Century England*, New Haven: Yale U. P. (1958) and Gillespie, N. C. 'Natural history, natural theology and social order: John Ray and the Newtonian ideology', *J. Hist. Biology*, (1987), 20, 1–49. For the problem of 'atheism' in the late seventeenth century see Berman, D. *A History of Atheism in Britain from Hobbes to Russell*, London: Routledge (1988); and Hunter, M. 'Science and heterodoxy: an early modern problem reconsidered', in Lindberg, D. C. and Westman, R. S. (eds.) *Reappraisals of the Scientific Revolution*, Cambridge: Cambridge U. P. (1990), pp. 437–60. For the position elsewhere in Europe see Kors, A. C. *Atheism in France, 1650–1729, Vol. 1: The Orthodox Sources of Disbelief*, Princeton: Princeton U. P. (1990), and Buckley, M., *At the Origins of Modern Atheism*, New Haven: Yale U. P. (1987).

19 The first use of the term (preceding the earliest OED citation by some two decades) may be in the title of Walter Charleton's *The Darkness of Atheism Dispelled by the Light of Nature, a Physico-Theologicall Treatise* (1652).

20 John Ray, *The Wisdom of God Manifested in the Works of the Creation* (1691); William Derham, *Physico-Theology: or, a Demonstration of the Being and Attributes of God, from His Works of Creation* (1713), and *Astro-Theology* (1715).

21 See especially Brooke, J. H. 'Why did the English mix their science and their religion?' in Sergio Rossi (ed.) *Science and Imagination in XVIIIth Century British Culture*, Milan: Unicopli (1987).

22 Notable exceptions are Philipp, W. 'Physicotheology in the age of Enlightenment: appearance and history', in *Studies on Voltaire and the Eighteenth Century*, (1967), 57, 1233–67, which however must be used with care; and Vermeulen, B. 'Theology and science: the case of Bernard Nieuwentijt's theo-logical positivism', in Rossi (ed.), *op. cit.* (21).

and further investigation might blur the edges of the picture.²³ The *correction* is more important for our present purpose. It is simply that for a large part of the eighteenth century—roughly from 1730 to 1800—the Argument did not flourish in Britain. I do not mean that it was rejected. On the contrary, it is endorsed, though usually briefly, in many works of the period.²⁴ But it would be difficult to cite any major British contribution to the Argument in these decades,²⁵ when by contrast it flourished in Continental Europe.²⁶

This calls for explanation. Without arguing the matter fully here, I suggest that the main reason for the temporary eclipse of the Argument in Britain was a perception that the battle against atheism had been won. It had always been a battle largely against straw men, for strict atheism—denial of the existence of a governing mind and power in the universe—had not been defended by any thinker of substance.²⁷ By the 1730s the debate had shifted to a more sophisticated level. The confusion of atheism with deism was no longer tenable, even for polemical purposes. The priority now was to confront real and vocal opponents: those who accepted the existence of a deity, but questioned miracles and prophecies, found contradictions in the Gospels, and dismissed the bulk of Christian doctrine as superstition. For these purposes the Argument was beside the point.

On this interpretation William Paley must be seen not just as the latest in a long line of exponents of the Argument in Britain, but as *reviving* a tradition that had been in abeyance for two generations or more. The revival of the tradition, like its earlier decline, requires explanation. In the course of the eighteenth century much had changed. Science had moved on, strengthening the case for design in some respects and weakening it in others.²⁸ The French

23 The role of Mersenne and Gassendi in the early stages of the genre deserves further investigation; for Gassendi see Osler, M. *Divine Will and the Mechanical Philosophy*, Cambridge: Cambridge U. P. (1994), pp. 51ff.

24 Representative examples include: A. A. Sykes, *The Principles and Connexion of Natural and Revealed Religion* (1740); James Foster, *Discourses on all the Principal Branches of Natural Religion and Social Virtue* (1749); Samuel Bourn, *Discourses on the Principles and Evidences of Natural Religion and the Christian Revelation* (1760–64); John Orr, *The Theory of Religion* (1762); James Tunstall, *Lectures on Natural and Revealed Religion* (1765); P. Doddridge, *Lectures on the Principal Subjects of Pneumatology, Ethics and Divinity* (1763); and Joseph Priestley, *Institutes of Natural and Revealed Religion* (1772–74).

25 John Wesley's lengthy *Survey of the Wisdom of God in the Creation* (1763), is avowedly based on German sources.

26 Major Continental examples are the Abbé Pluche's *Spectacle de la Nature*. (8 vols. 1732–50; English edn. 1733–); H. S. Reimarus, *The Principal Truths of Natural and Revealed Religion Defended and Illustrated* (1754; English edn. 1766); Johann Süssmilch, *Die Göttliche Ordnung* (1765); F. C. Lesser, *Insecto-Theology* (1738; English edn. 1799); C. C. Sturm, *Reflections on the Works of God* (before 1788; several English translations); Clement de Boissy, *L'Auteur de la Nature* (3 vols., 1782); Bernadin de St. Pierre, *Études de la Nature* (3 vols., 1784; several English translations); and J. F. Martinet, *The Catechism of Nature* (4 vols.; an English abridgement was published in 1790).

27 The pantheism of Spinoza and Toland is difficult to interpret, but Toland, at least, appeared to accept design in the Universe: see his *Letters to Serena* (1704), p. 235.

28 Odom, H. H. 'The estrangement of celestial mechanics and religion', *J. Hist. Ideas*, (1966), 27, 533–548; and Gascoigne, J. 'From Bentley to the Victorians: the rise and fall of British Newtonian natural theology', *Science in Context*, (1988), 2, 219–56 discuss the declining role of astronomical evidence in natural theology.

philosophes had come to fame (or notoriety); new, speculative accounts of the organic world had been given by Buffon and others; and Hume had called the very basis of the Argument into question. Overt atheism had emerged for the first time in the work of d'Holbach, and found exponents even in Britain.²⁹ In the wake of the French Revolution religious infidelity and scepticism, closely linked with political radicalism, seemed to threaten the foundations of society. A vigorous response was needed.

Clergy in both the established and dissenting churches played a major part in the propaganda war against infidelity.³⁰ Paley's own first venture into popular theology, the *Evidences of Christianity*, was a huge success. Friends and patrons encouraged him to continue his efforts.³¹ At the beginning of the nineteenth century there was still a demand for an authoritative, comprehensive and up-to-date presentation of the argument from design. Paley was well placed to provide it.

The Varieties of Argument

I have so far assumed that the basis of the Argument is familiar. It has been generally regarded as an argument from analogy.³² Natural objects (particularly organisms) are similar in certain ways—regularity, complexity, or apparent subservience to a purpose—to human artefacts.³³ Human artefacts are the product of intelligent design. By analogy, so are natural objects. The closer the similarity, the stronger the force of the analogy.

Analogy is certainly an important element in the tradition of the Argument, and it may well be that an appeal to analogy with human artefacts is always at least *implicit*. Nevertheless, not all versions of the Argument rely overtly on analogy, and many make greater use of a strategy of *exclusion*.³⁴ The regularity,

29 See Berman, *op. cit.* (18) for an account of radical atheism in the 1790s.

30 Apart from the works of Paley himself, we may mention the very popular writings of Bishop Richard Watson in response to Gibbon and Paine; similar works by the unitarian convert Gilbert Wakefield; the unitarian John Prior Estlin's *The Nature and Causes of Atheism* (1797); the Baptist Robert Hall's *Modern Infidelity Considered with Respect to its Influence on Society* (1799); and, not least, many works of Joseph Priestley. Dissenters and 'liberal' Anglicans seem to have played a disproportionate role in the propaganda war, and it has been suggested that High-Churchmen were less well-equipped for debate with sceptics who did not share their basic presuppositions: see Aston, N. 'Horne and heterodoxy: the defence of Anglican beliefs in the late Enlightenment' in *Eng. Hist. Rev.*, (1993), 108, 895–919.

31 In the Preface to the *Natural Theology* Paley noted that the Bishop of Durham had urged him to its writing, and his friend John Law told him during its preparation that it was 'infinitely wanting for the confutation of French and English atheism': see Edmund Paley, *op. cit.* (1), p. 334.

32 McPherson, T. *The Argument from Design*. London: Macmillan (1972), *passim*; Gerson, L. P. *op. cit.* (16), p. 156; Brooke, J. H. *op. cit.* (12), p. 69; and Gaskin, J. *Hume's Philosophy of Religion*, London: Macmillan (1978), p. 10, may serve as representative examples.

33 Several modern commentators see an important distinction between the appeal to *regularity* and the appeal to *purpose* or *function* as evidence of design. Whatever the theoretical merits of this distinction, it is not made with any clarity by most exponents of the Argument before the 19th century.

34 Particularly clear examples of this strategy can be found in Edward Stillingfleet, *Origines Sacrae* (1662); Richard Bentley, *The Folly and Unreasonableness of Atheism* (1692–3); and George Cheyne, *Philosophical Principles of Natural Religion* (1705).

utility, etc. of natural phenomena appear to call for explanation. Alternatives to design are examined and rejected, leaving design as the only viable option. Three such alternatives were routinely examined in the seventeenth and eighteenth century: the existence of the world in its present state from eternity; the production of order by fixed laws of nature or 'necessity'; and the emergence of order by chance.

The eternity of the world in its present state was easily dismissed. Even when an eternal succession of past events was not rejected as a logical absurdity,³⁵ the doctrine faced empirical objections. In eternity the mountains would long have been worn away, and man would have exhausted his powers of discovery and invention. This was evidently not the case.³⁶ The production of order by fixed laws of nature was, if anything, given even shorter shrift. The principal objection was not that the doctrine was false, but that it was empty. The notion that 'nature' or 'necessity' could spontaneously produce the complex, goal-directed pattern of the world (or of organisms) was scarcely intelligible. 'Nature' was not an entity capable of action or foresight, unless indeed it were given the attributes of the Deity. If it were not, then this alternative proved, on analysis, to differ only verbally from mere chance.³⁷

The Epicurean doctrine of *chance* was the main target of the physico-theologians. It was the only alternative to design to have been developed in detail, above all by Lucretius.³⁸ Lucretius had two ways of explaining the *appearance* of purpose in organisms. One was the notion that 'the part precedes the use': the organs of animals were created by chance, and their possessors discovered uses for them after the event.³⁹ The other idea superficially resembled that of natural selection: a variety of organisms emerged by chance from lifeless matter, but most were monstrous, and only a minority could survive and reproduce.⁴⁰

It was easy to show the absurdities of the Epicurean theory, and theologians

35 A line of argument going back to John Philoponus in the 6th century objected that an actual infinity of past events involved mathematical contradictions; despite a pungent critique by Hobbes (*De Corpore*, in *The English Works of Thomas Hobbes of Malmesbury*, ed. Molesworth, (1839), Vol I, p. 413) this theme remained popular in the eighteenth century.

36 For a few of many refutations along these lines see John Wilkins, *The Principles and Duties of Natural Religion* [1675], 6th ed., (1710), pp. 71ff; George Cheyne, *op. cit.* (34), Part II, p. 50ff; and P. Doddridge, *op. cit.* (24), in *Works*, Leeds, (1803), IV, p. 350ff. An interesting later example is in Erasmus Darwin's *The Temple of Nature* (1803), Canto I, note to line 224, where Darwin concludes 'The juvenility of the earth shows, that it has had a beginning or birth, and is a strong natural argument evincing the existence of a cause of its production, that is of the Deity'.

37 For a few such arguments see William Whiston, *Astronomical Principles of Religion, Natural and Revealed* [1717], 2nd ed., (1725), p. 195; Thomas Morgan, *Physico-Theology* (1741), p. 142; A. A. Sykes, *op. cit.* (24), p. 69; J. P. Estlin, *The Nature and the Causes of Atheism*, Bristol (1797), pp. 6-7; and Abraham Tucker, *The Light of Nature Pursued*, (1760-74) ed. Sir H. P. St John Mildmay, (1837), I, p. 326; Tucker, it may be noted, was one of Paley's favourite authors.

38 Lucretius, *The Nature of the Universe*, tr. Latham, R. E., Harmondsworth: Penguin (1951). For the reputation of Lucretius in the eighteenth century see Fleischmann, W. 'The debt of the Enlightenment to Lucretius', in *Studies on Voltaire and the Eighteenth Century*, (1963), 25, 631-643; and Gay, P. *The Enlightenment: An Interpretation. 1. The Rise of Modern Paganism*, [1966], New York: Wildwood House, (1973), p. 99ff.

39 Lucretius, *op. cit.* (38), p. 156.

40 *Ibid.*, pp. 196-8.

assailed it from every angle. They could point out that its assumptions were inconsistent: that it required simultaneously a violent flux of recombining atoms, and conditions peaceful enough for the survival of man and other creatures.⁴¹ Alternatively they could show its incompatibility with the actual laws of nature; not least with Newton's law of universal gravitation.⁴² As to the Lucretian doctrine of 'selection' in organic nature, it could be shown to be both *unfounded*—since spontaneous generation, at least above the microscopic level, had been disproved⁴³—and *inadequate* to explain the observed phenomena, for it failed to account for the fact that organisms were far *better* adapted than was necessary for bare survival. As John Ray triumphantly remarked, 'the atheists' usual flam will not here help them out'.⁴⁴ Nor could the doctrine that 'the part precedes the use' fill the gap, since it could not be applied to internal organs of which their possessors knew nothing and which they did not control.⁴⁵

Even if the hypothesis of chance were not rejected as impossible, it could be stigmatized as grossly *improbable*. Cicero had set the pattern for this objection by comparing the probability that the world was formed by chance with the probability that a heap of letters thrown at random on the ground would replicate the *Annals* of the poet *Ennius*.⁴⁶ In the eighteenth century it was reinforced by quantitative estimates of probability.⁴⁷ An interesting but little-known example is an early work of the moral philosopher Francis Hutcheson. By examining the ratio of 'orderly' to 'disorderly' possible states of the universe, he concluded that the odds against the order of nature being due to chance 'must be near the infinitesimal power of infinity to unity'.⁴⁸ From a modern point of view such arguments are problematic. By the usual rules of inverse probability we cannot infer design from the fact of order in nature merely by showing the improbability of the alternatives. It is necessary also to show that

41 This objection is developed with great skill by Fontenelle in his essay *Sur l'Existence de Dieu, in Oeuvres Complètes, Corpus des Oeuvres de Philosophie en Langue Française*, Paris, (1989), III, pp. 161–7.

42 This argument is strongly put by Richard Bentley, *op. cit.* (34), and found most accessibly in Goodman, D. C. (ed.), *Science and Religious Belief 1600–1900: A Selection of Primary Sources*, Milton Keynes: Open University Press (1973), pp. 137–77.

43 The classic discussion is in John Ray, *The Wisdom of God Manifested in the Works of the Creation*, ('Dove's English Classics', 1827), pp. 246ff.

44 John Ray, *op. cit.* (43), 138. See also Bentley, *op. cit.* (34), in *The Works of Richard Bentley*, ed. A. Dyce, Vol III, (1838), pp. 107ff; William Derham, *Physico-Theology*, new edition, (1798), I, p. 253; and most fully, Samuel Collier, *An Impartial Enquiry into the Existence and Nature of God* (1718), pp. 75ff.

45 The objection is put brilliantly by Boyle in *A Disquisition about the Final Causes of Natural Things*, in *Works*, ed. T. Birch, (1744), III, p. 538.

46 Cicero, *op. cit.* (17), pp. 161ff.

47 See Pearson, K. *The History of Statistics in the 17th and 18th Centuries*, ed. Pearson, E.S., New York: Macmillan (1978), chs. 9 and 10; Hacking, I. *The Emergence of Probability: A Philosophical Study of Early Ideas about Probability, Induction and Scientific Inference*, Cambridge: Cambridge U. P. (1975), pp. 166–75; and Daston, L. *Classical Probability in the Enlightenment*, Princeton: Princeton U. P. (1988), pp. 130ff and 266f.

48 Francis Hutcheson, *An Inquiry into the Original of our Ideas of Beauty and Virtue*, 2nd ed., (1726), pp. 47–68, evidently using the term 'infinitesimal' in the obsolete sense of 'very large', not 'very small'.

the hypothesis of design has an appreciable antecedent probability, and, as John Maynard Keynes remarked, 'it is our ignorance of this, as a rule, that we are endeavouring to remedy'.⁴⁹

Keynes's verdict would not have been accepted without protest in the eighteenth century. The *a priori* probability of design required to fill the gap in the argument is a modest one. Hutcheson would have seen no problem: 'An intelligent cause is surely at least as probable a notion as chance, general force, or the *clinamen principiorum* to account for any effect whatsoever'.⁵⁰ Later in the century mathematicians were willing, following Thomas Bayes, to make daring *a priori* assignments of probability, based solely on the equal distribution of our ignorance among the hypotheses. In introducing Bayes's Theorem to the world Richard Price was quick to note its relevance to 'the argument taken from final causes for the existence of the Deity'.⁵¹

We have seen that a variety of resources was available to the theorist of design in the eighteenth century. The latest scientific and mathematical ideas were put to use. If the Argument was not watertight, it was still persuasive, since few would reject the thesis of design in the absence of a plausible alternative. Objections to design, however, were not wholly silenced.

Objections to Design

Many of the objections were as old as the Argument itself. Lucretius and Sextus Empiricus had voiced the most common criticism: that the world was imperfect and full of evils: how then could it be the work of a perfect intelligence? The objection was echoed in the eighteenth century by Diderot and Hume, but on the whole was taken by theologians more as a challenge to God's *benevolence* than to his *existence*.⁵² A different line of objection was based on criticism of the concept of purpose or *final causes* in nature. Bacon's methodological side-swipe at these 'barren virgins' was familiar and often repeated. The philosophy of final causes could also be attacked, in the manner of Descartes, for the *presumption* of the claim to know God's purposes; or for the supposed indignity of involving God in trivial anatomical details: in the famous phrase of Buffon, to suppose him 'occupé de la manière dont se doit plier l'aile d'un scarabe'.⁵³ But objections

49 Keynes, J. M. *A Treatise on Probability* (1921), in *The Collected Writings of John Maynard Keynes*, Vol VIII, Cambridge: Cambridge U. P. (1973), p. 329.

50 Hutcheson, *op. cit.* (48), p. 63.

51 R. Price, in *Facsimiles of Two Papers by Bayes, prepared under the direction of Edward Deming*, Department of Agriculture, Washington, n.d., pp. 373–4. Elsewhere (*Four Dissertations*, [4th edn. text, 1771], (1811), p. 290) Price made a start towards developing an explicitly Bayesian version of the Argument, but this approach was never, so far as I am aware, fully worked out.

52 An excellent study of eighteenth century views on the problem of evil is contained in La Vergata, A. *L'Equilibrio e la Guerra della Natura: dalla Teologia Naturale al Darwinismo*, Naples: Morano (1990).

53 Buffon's remark can be found towards the end of his *Discours sur la Nature des Animaux*. Less well-known is Condillac's riposte, 'Comment se plieroit cette aile si Dieu ne s'en occupoit pas?' in his *Traité des Animaux, Oeuvres de Condillac*, Vol 3, Paris, (1798), p. 519. Other French objections to the use of final causes include J-B Robinet, *De La Nature*, Amsterdam, (1761–68), Vol I, p. 9.

to final causes were raised more often in France than in Britain, where Robert Boyle had carefully examined the concept of purpose in nature and justified its cautious and selective use.⁵⁴ His British successors in the eighteenth century saw no reason to reject his analysis.

Thus far, nothing had occurred to shake the confidence of eighteenth century theologians in the essential soundness of the Argument. Nor did the scandalous treatise of the Baron d'Holbach on the *Système de la Nature* arouse anxiety in Britain when it appeared in 1770.⁵⁵ Based on outdated physics (more Cartesian than Newtonian), and naive confidence in the possibility of spontaneous generation,⁵⁶ it contained little to worry an informed reader. In its positive doctrine, it relied on an unexamined notion of a provident and creative Nature: as Joseph Priestley, one of the few in Britain to find it worth refuting, remarked, d'Holbach's Nature 'is indeed no bad substitute for a deity, but then it would be, in fact, only another name for the same thing'.⁵⁷ The negative doctrines of the *Système* were more interesting for our present purpose, for they included an explicit critique of the Argument. Intriguingly, d'Holbach considered in detail the example of a watch—so prominent in Paley's later work—and what might legitimately be inferred about its origins by someone (a savage) who had never seen a watch before. While accepting that to a savage the watch must be the work of 'some intelligent agent of greater ability, possessing more industry than himself', and that we may draw the same inference about the works of nature, in d'Holbach's view we are no more entitled than the savage to infer the existence of an immaterial power distinct from nature itself. Nothing in the evidence goes beyond the realm of nature, whose powers are still imperfectly known.⁵⁸

Whatever the interest of d'Holbach's critique, it was quickly superseded for British readers by the more elaborate and sophisticated treatment of the theme

53 (Contd) where he objects on methodological grounds, and in Vol II where he argues at length for the impossibility of knowing the aims of God; Maupertuis, in the *Essai de Cosmologie*, reprinted in his *Oeuvres*, Hildesheim, (1965), I, pp. 12ff; Diderot, *De l'Interpretation de la Nature*, in *Oeuvres Philosophiques*, ed. Vernière, P., Paris, (1956), pp. 235f; and D'Alembert, for whose view of final causes see Hankins, T. L. *Jean D'Alembert: Science and the Enlightenment*, Oxford: Oxford U. P. (1970), p. 54.

54 For Boyle's arguments see Lennox, J. G. 'Robert Boyle's defense of teleological inference in experimental science', *Isis*, (1983), 74, 38–53 and Shanahan, T. 'Teleological reasoning in Boyle's Disquisitions about Final Causes', in Hunter, M. (ed.) *Robert Boyle Reconsidered*, Cambridge: Cambridge U. P. (1995).

55 d'Holbach, *The System of Nature or, The Laws of the Moral and Physical World*, [1770] London, (1844). For d'Holbach's ideas see Naville, P. *D'Holbach et la philosophie scientifique au XVIII^e siècle*, nouvelle édition, Paris, (1967); Kors, A. C. *D'Holbach's Coterie: An Enlightenment in Paris*, Princeton: Princeton U. P. (1976); and Porset, C. 'Le Système de la Nature et la téléologie', *Studies on Voltaire and the Eighteenth Century*, (1980) 190, 502–7.

56 d'Holbach accepts without question the already widely discredited experiments of Needham: see Roe, S.A. 'John Turberville Needham and the generation of living organisms', *Isis*, (1983), 74, 159–84; and 'Voltaire versus Needham: atheism, materialism and the generation of life', *J. Hist. Ideas*, (1985), 46, 65–87.

57 Joseph Priestley, *Letters to a Philosophical Unbeliever*, Birmingham, 2nd ed., (1787), pp. 172–3.

58 d'Holbach, *op. cit.* (55), pp. 348ff.

in Hume's posthumous *Dialogues Concerning Natural Religion*.⁵⁹ It would be superfluous here to discuss Hume's work in detail.⁶⁰ One point must however be emphasised for our present purpose. It is well known that for Hume the Argument is based on an *analogy* between natural objects and human artefacts.⁶¹ In Hume's philosophy analogy is a species of *induction*. But it is important to be clear that Hume's *general* scepticism about induction and causality is not at issue in the *Dialogues*.⁶² His aim is to show that the *particular* inference from nature to a designing God is weak: his criticism is not of analogy as a form of argument, but of the force of a particular analogy.

From the assumption that the Argument is based on analogy, Hume's critique takes two directions.⁶³ In one he accepts the analogy as valid but insists that it must be taken seriously. Many of the conventional attributes of God—his unity, his eternity, his omnipotence, his perfect goodness and wisdom—go far beyond any inference we can draw from analogy with human design. The Argument may prove the existence of design in nature, but not the existence of *God* as commonly conceived.⁶⁴ In the other direction, Hume questions the validity of the analogy itself. The strength of any argument from analogy depends on the similarity of the items compared. But the differences between natural and artificial objects are too fundamental for any worthwhile conclusions to be founded on the comparison.⁶⁵

Hume's *Dialogues*, despite their radical implications, attracted fewer refutations than some of his earlier work. Nevertheless, they were not wholly ignored. One complaint was that Hume failed to put the Argument in its strongest light,⁶⁶ while some of his more daring speculations exposed him to ridicule.⁶⁷ More substantial responses to the *Dialogues* followed two main strategies. One, taken by the Scottish philosophers of the 'Common Sense' school, was to reject the

59 David Hume, *Dialogues Concerning Natural Religion* (1779) in *Dialogues and Natural History of Religion*, ed. Gaskin, J., Oxford: Oxford U. P. (1993). To some extent the arguments of the *Dialogues* had been foreshadowed in Hume's *Enquiries Concerning Human Understanding and Concerning the Principles of Morals* [1748–51], ed. Selby-Bigge, L. A. revised by Nidditch, P. H., Oxford: Oxford U. P. (1975).

60 A comprehensive analysis is given in Gaskin, J. *op. cit.* (32)

61 Hume, *op. cit.* (59), pp. 45ff. Hume's assumption is widely shared by modern commentators, but I have argued that it is an over-simplification.

62 If I understand him correctly, I differ here from Brooke, J. H. 'Natural Theology in Britain from Boyle to Paley' in *New Interactions between Theology and Natural Science*, Milton Keynes: Open University Press (1974), p. 45.

63 Gaskin, *op. cit.* (32), describes these as 'Restrictions on the Conclusion' and 'Weakness in the Analogy'.

64 *Enquiries*, pp. 132–48; *Dialogues*, pp. 58ff.

65 *Dialogues*, pp. 49ff. In the *Enquiries* he had only hinted at this line of criticism.

66 See, for example Joseph Priestley, *op. cit.* (57), Letter IX; Lord Kames, *Essays on the Principles of Morality and Natural Religion*, 3rd edn., Edinburgh, (1779), p. 368; and *Monthly Review*, (1779), 61, p. 343. Hume was at his weakest in treating the alternatives to design, where he offered the hackneyed theories of spontaneous generation and Lucretian selection without hinting at the standard objections to them.

67 Thus Bishop George Horne's *Letters on Infidelity in The Works of the Right Reverend George Horne*, ed. William Jones, (1809), Vol. VI, pp. 397ff, mocks Hume's 'panspermatic' speculation (*Dialogues*, p. 79) that seeds of new worlds are spread throughout the universe.

basic empiricist premise that our knowledge is derived wholly from experience, and appeal to an *intuition* of design in nature. This was the position of Lord Kames, who considered that our inference of 'an intelligent designing cause', whenever we saw 'an effect properly adapted to some end', was the result of an 'intuitive conviction'.⁶⁸ Kames's position was adopted by Thomas Reid,⁶⁹ the leading figure in the Common Sense school, and elaborated most fully by James Oswald.⁷⁰

For those who wished to combine belief in God with strict empiricism, the approach of the Scottish school was almost as objectionable as that of Hume himself. To Joseph Priestley it was anathema, and his response to the Scottish thinkers⁷¹ is among the most polemical works in a literary career not noted for restraint. If design could not be demonstrated solely from experience, but depended on a special intuitive faculty, the Argument would stand or fall with the existence of such a faculty. Since this was at best doubtful, the 'defence' of religion by Oswald had done it more harm than good.⁷² It is not surprising then that Priestley's own response to Hume followed a different path, insisting that the inference from the order of nature to a designer is soundly based in experience. Our observation of human artefacts convinces us that 'wherever there is a fitness or correspondence of one thing to another, there must be a cause capable of comprehending, and of designing that fitness'. This conclusion is based on our 'constant experience and observation' and 'follows from the strongest analogies possible'.⁷³

Whatever may be said of the quality of such responses,⁷⁴ Hume had not been ignored. For those who adhered to strict empiricism, it was a matter of judgement of the facts, and not of philosophical principle, whether to accept Hume's conclusions. In practice few, unless motivated by hostility to religion, would give up the comforting thesis of design without a plausible alternative. Hume's own alternatives, far from being the anticipations of Charles Darwin supposed by Hume's hagiographers, were merely the detritus of the Epicurean tradition. But as the eighteenth century reached its close, a new factor had to be reckoned with.

68 Lord Kames, *op. cit.* (66), p. 304; pp. 325–337.

69 See Thomas Reid, *Essays on the Intellectual Powers of Man* (1785) in Works, ed. W. Hamilton, 4th edn., Edinburgh, (1854), pp. 457ff. In a letter of 1775 from Reid to Kames, *ibid.*, p. 54, Reid acknowledges Kames's influence in this respect. The Scottish writers knew of Hume's radical views from personal contacts long before their publication.

70 James Oswald, *An Appeal to Common Sense in Behalf of Religion*, 2nd edn., (1768).

71 Joseph Priestley: *An Examination of Dr Reid's Inquiry into the Human Mind on the Principles of Common Sense; Dr Beattie's Essay on the Nature and Immutability of Truth; and Dr Oswald's Appeal to Common Sense in Behalf of Religion*, in *The Theological and Miscellaneous Works of Joseph Priestley*, ed. J. T. Rutt, vol III, (1818).

72 Priestley, *Ibid.*, p. 134.

73 Priestley, *op. cit.* (57), pp. 35–43.

74 Popkin, R. 'Joseph Priestley's criticism of Hume's philosophy', in *J. Hist. Philosophy*, (1977), 15, 437–47, pronounces unfavourably on Priestley's approach.

The Emergence of Evolutionism

The study of evolutionism in the eighteenth century has been plagued by the hunt for *precursors*. Many Enlightenment figures have been credited with anticipating the theories of Lamarck or Darwin. More critical scholarship has scaled these claims severely down.⁷⁵ Indeed, scholars are now more likely to debate why the eighteenth century, despite the desire of many for a non-religious account of the organic world, did *not* produce a systematic theory of evolution.⁷⁶

The empirical evidence for progressive evolution from the fossil record was not compelling. If hard evidence for evolution was lacking, philosophical precedent was also weak. The thinkers of antiquity—whose importance for the *philosophes* can hardly be overestimated—provided no clear model for an evolutionary theory. Nor did evolutionism by itself suffice for a non-religious account of the living world. As evolution presupposes the existence of living things, a purely naturalistic account must at some point invoke the generation of life from inorganic matter.⁷⁷ Why then not let organisms be generated in more or less their present form, and dispense with evolution altogether?

We find accordingly that for much of the eighteenth century evolution and spontaneous generation were rival, rather than complementary, explanations of the organic world.⁷⁸ Nevertheless, the evolutionary approach gained ground. A modest amount of transformation was almost forced on naturalists by the facts of comparative anatomy, geographical variation and hybridism. More radical speculations were familiar, if not widely accepted, from mid-century onwards. The idea that nature had a *history* became established. While this by no means necessitated an evolutionary theory of the organic world—the alternatives included a succession of divine creations, or the development of preexisting germs⁷⁹—evolution was one available option, and an attractive one to those who sought a non-religious account. By the 1790s 'advanced'

75 Milestones in the development of a more critical approach are Greene, J. C. *The Death of Adam: Evolution and its Impact on Western Thought*, Ames, Iowa: Iowa State U. P., (1959); and Roger, J. *Les Sciences de la Vie dans la Pensée Française du XVIII^e Siècle*, Paris, [1963], 2nd. edn. (1971). More recent surveys are given by Bowler, P. 'Evolutionism in the Enlightenment', *Hist. Sci.*, (1974), 12, 159–185; and Roger, J. 'The living world' in Rousseau, G. and Porter, R. (eds.), *The Ferment of Knowledge: Studies in the Historiography of Eighteenth-Century Science*, Cambridge: Cambridge U. P. (1980).

76 See Bremner, G. 'The impossibility of a theory of evolution in eighteenth-century French thought', in *Studies on Voltaire and the Eighteenth Century*, (1983), 216, 309–11.

77 Theoretically it could be argued that life had existed from eternity, but this raised formidable problems of its own.

78 Farley, J. *The Spontaneous Generation Controversy from Descartes to Oparin*, Baltimore: Johns Hopkins U. P. (1977), stresses the persistence of the doctrine of spontaneous generation in the eighteenth century, even after Spallanzani's careful experimental refutation, but he may overestimate its respectability among competent critics. In Britain, at least, spontaneous or 'equivocal' generation was authoritatively described as 'completely refuted': see William Smellie, *The Philosophy of Natural History*, Edinburgh, vol. II, (1799), p. 79. Erasmus Darwin's endorsement of spontaneous generation in *The Temple of Nature* (1803), was sharply criticized for failing to mention Spallanzani: see *Monthly Review*, New Series, (1804) 43, 113–27.

79 Bowler, *op. cit.* (75), has a useful discussion of the alternatives.

evolutionary views—in print, in manuscript, or in oral discussion—were commonplace in France.⁸⁰

Such views were not unknown in Britain. Sir Richard Sullivan, a quirky but well-informed guide to the thought of the period, recorded that:

The formation of men and animals long puzzled those world-makers, who would attribute everything to material causes. At length a discovery was supposed to be made, of primitive animalcules, of organic molecules, from whom every kind of animal was formed. It was found out, that nature one day teeming in the vigour of youth, produced the first animal, a shapeless, clumsy, microscopical object. This, by the natural tendency of original propagation, to vary and protect the species, produced others better organised. These again produced others more perfect than themselves, till at last appeared the most complete species of animals, the human kind, beyond whose perfection it is impossible for the work of generation to proceed.⁸¹

This clear description of a radical evolutionary position just pre-dates the *Zoonomia* of Erasmus Darwin. Darwin had certainly adopted evolutionary views some years before, but the *Zoonomia* provided the first full account of his position.⁸² For Darwin evolutionary change is an extension of the normal process of *generation*. Each individual organism is produced by the development of a 'simple living filament', endowed with irritability: the capability of being excited into action by a stimulus. Under such stimuli the filament absorbs nutriment, changes its shape, and begins to acquire distinct organs. With the formation of new organs, new forms of irritability and sensibility are acquired. Each new organ also has an *appetency* or propensity: an urge to meet its needs or desires. As development continues, the exercise of these various appetencies, and the resulting exertion of the parts, shapes the final form of the full-grown organism.⁸³

Since the 'filament' from which each individual develops is literally an offshoot of its parent, it is to be expected that its properties will be influenced by its parents' experience.⁸⁴ Darwin unhesitatingly accepts the current doctrine

80 See Burkhardt, R. W. *The Spirit of System: Lamarck and Evolutionary Biology*, Cambridge, Mass.: Harvard U. P. (new edn., 1995), p. 86 and pp. 202ff; and Corsi, P. *The Age of Lamarck: Evolutionary Theories in France, 1790–1830*, revised edn., tr. Mandelbaum, J., Berkeley: University of California Press, (1988), pp. 83ff. for the prevalence of evolutionary doctrines in France around 1800. No doubt this outburst of evolutionary doctrines was related in some way to the circumstances of the French Revolution, if only by the relaxation of religious censorship.

81 R. J. Sullivan, *A View of Nature, in Letters to a Traveller among the Alps, with Reflections on the Atheistical Philosophy now exemplified in France*, 6 vols., 1794, IV, p. 6. Sir Richard Joseph Sullivan, Bart, FRS, MP (1752–1806) wrote several large works on travel, philosophy, antiquities and science: see the *Dictionary of National Biography* entry under the alternative spelling 'Sullivan'.

82 Volume 1 of the first edition appeared in 1794, a slightly revised text of Volume 1, together with Volume 2, was published as the second edition in 1796, while the third edition appeared in four volumes in 1801. The most useful guides to Darwin's theories are Porter, R. *op. cit.* (10), and Harrison, J. 'Erasmus Darwin's view of evolution' in *J. Hist. Ideas*, (1971), 32, 247–64.

83 For Darwin's theory of generation see *Zoonomia*, (1801), II, pp. 221–6.

84 *Ibid.*, p. 200. Darwin considers that the 'filament' is an offshoot of the father, while the mother provides nutrition for the growing foetus and influences it in that way.

of the inheritance of acquired characteristics.⁸⁵ Applying this not just to individuals but to varieties and species, it is evident that different experiences might lead to the exercise of different appetencies or propensities, and thus to divergent bodily forms. The varieties of domesticated animals, and the geographical variation of wild ones, give reason to think that this had actually happened.⁸⁶ The needs for sex, *food* and *security* are the three great wants which have 'diversified the forms of all species of animals', leading to such special adaptations as the elephant's trunk and the talons of the beasts of prey.⁸⁷

Amidst a generally favourable reception for the *Zoonomia*, the theory of generation and evolution attracted criticism from the outset. The liberal *Monthly Review* referred to Darwin's 'ingenious fancy in working up a little fact with abundance of conjecture, into that product of mental generation called an *hypothesis*. What an acquisition would such a system have been to Mr Shandy!'⁸⁸ The theory seems in general to have aroused more amusement than alarm.⁸⁹ Yet in one respect the *Zoonomia* had more far-reaching implications than any previous evolutionary speculation. By postulating that evolutionary change was the result of the active exertion of organisms, in the effort to satisfy their needs or appetencies, it offered in principle a new solution to the problem of *adaptation*. Where previously those who wished to avoid the option of design had either, like Buffon or Maupertuis, played down the extent of adaptation, or ascribed it to the happy accident of Lucretian selection, Darwin was the first to develop a theory that both recognised adaptation and offered a mechanism for it.⁹⁰ This threat to the argument from design was new and serious. At last there was a naturalistic alternative to Epicurus.

The Strategy of the Natural Theology

To return to Paley. The basis of the argument of the Natural Theology can be set out most clearly in his own words:

Wherever we see marks of contrivance, we are led for its cause to an *intelligent* author. And this transition of the understanding is founded upon uniform experience. We see intelligence constantly contriving; that is, we see intelligence constantly producing effects, marked and distinguished by

85 For the growing prevalence of the doctrine towards the end of the eighteenth century see Zirkle, C. 'The early history of the idea of the inheritance of acquired characters and pangenesis', *Trans. Amer. Phil. Soc.*, (1946), 35, 91–151.

86 *Zoonomia*, II, p. 234.

87 *Ibid.*, pp. 236–9.

88 *Monthly Review*, New Series, (1794), 15, 1–14; see also Thomas Brown, *Observations on the Zoonomia of Erasmus Darwin M.D.*, Edinburgh, (1798), p. 463. Garfinkle, N. 'Science and religion in England, 1790–1800: the critical response to the work of Erasmus Darwin', *J. Hist. Ideas.*, (1955), 16, 376–88, argued that responses to Darwin became more hostile in the course of the 1790s as a result of growing conservative reaction to the French Revolution.

89 The evolutionary theory of the *Zoonomia* was satirised in a note to verse 39 of *The Loves of the Triangles*, the celebrated parody of Darwin's poetic style in the *Anti-Jacobin* magazine.

90 A case may be made for the priority of Diderot's *Rêve de D'Alembert* in this respect, but Diderot touched upon the point only in passing and the work was not printed or widely known until well into the 19th century.

certain properties; not by certain peculiar properties, but by a kind and class of properties, such as relation to an end, relation of parts to one another, and to a common purpose. We see, wherever we are witnesses to the actual formation of things, nothing except intelligence producing effects so marked and distinguished. Furnished with this experience, we view the productions of nature. We observe *them* also marked and distinguished in the same manner. We wish to account for their origin. Our experience suggests a cause perfectly adequate to this account. No experience, no single instance or example, can be offered in favour of any other. In this cause therefore we ought to rest; in this cause the common sense of mankind has, in fact, rested, because it agrees with that which in all cases, is the foundation of knowledge—the undeviating course of their experience ...⁹¹

The robust empiricism of this passage reminds us of Priestley's response to Hume.⁹² The strategy of Paley's own work may usefully be analysed in relation to Hume's challenge.⁹³ We recall that Hume had two distinct lines of attack: to show that the traditional attributes of God could not be inferred from the analogy of nature with human artefacts; and to undermine the analogy itself. Paley's response to the first attack is to make a tactical withdrawal; giving up or qualifying many of the traditional attributes of God, the better to defend the most essential ones.⁹⁴ Such attributes as unity, omnipotence, omniscience, omnipresence, and eternity are all redefined by Paley in radically limited terms; for example 'the whole argument for the divine unity goes no further than to a unity of counsel'.⁹⁵ Paley's God is left with a minimum of attributes, but enough (he argues) to underpin the credibility of the Christian revelation.⁹⁶ For this it is sufficient that God shows plan, intelligence and foresight; inconceivable power; and evident *goodness*, for 'in a vast plurality of instances in which contrivance is perceived, the design of the contrivance is *beneficial*'.⁹⁷

Hume's more fundamental challenge denies the validity of the analogy between artefacts and natural objects. Paley's strategy is vigorously to defend it. Man-made devices (watches, telescopes) are compared with natural organs

91 *Natural Theology*, ch. 23, pp. 444–5. (I will give page references to the first edition (1802), but to facilitate references to other editions will also give chapter numbers).

92 The similarity may not be accidental, for Paley's chapter begins with a reference to Priestley's *Letters to a Philosophical Unbeliever*, where Hume's *Dialogues* are discussed.

93 It is impossible to be sure how far Paley in fact had Hume's *Dialogues* in mind in his planning of the *Natural Theology*, but, contrary to some assertions, he certainly knew of them. He explicitly refers (ch. 26, p. 548) to Hume's discussion of idleness (Hume *op. cit.* (59), pp. 110–11), and his objections to reliance on a principle of *generation* (*Natural Theology*, ch. 23, pp. 452–7) or of order (*Natural Theology*, ch. 1, p. 7) clearly allude to Hume; compare the passages just cited with Hume, *op. cit.* (59), pp. 76–7 and 78–82.

94 This aspect of Paley's strategy has been well noted by Stewart, M. A. 'The Scottish Enlightenment' in Brown, S. (ed.) *British Philosophy in the Age of Enlightenment*, London: Routledge (1996), p. 286; Stewart also describes the opening of the *Natural Theology* as 'a systematic riposte' to Hume.

95 *Natural Theology*, ch. 24, pp. 474–81. The same concession is made by Priestley, *op. cit.* (57), pp. xviii–xix, explicitly in response to Hume.

96 For Hume natural theology is important primarily as a foundation for revealed theology and moral philosophy: *Natural Theology*, Preface, p. vii and ch. 27, p. 579.

97 *Natural Theology*, ch. 26, p. 488.

(notably the eye) and both are said to display such properties as 'subserviency to a use, and relation to an end';⁹⁸ from which Paley concludes that in each case an artificer must have existed 'who comprehended its construction, and designed its use'.⁹⁹ By his own account, it is his desire to show the similarity of natural and artificial objects that leads him to concentrate on the most *mechanical* features of organisms; those, such as the human eye or spinal column, where many components work together with precision to serve an obviously useful purpose.¹⁰⁰ In a certain sense, animals (or parts of animals) actually *are* machines: 'That an animal is a machine is neither correctly true nor wholly false ... I contend ... that there is mechanism in animals; that this mechanism is as properly such, as it is in machines made by art; ... that whenever it is intelligible and certain, it demonstrates intention and contrivance, as well in the works of nature as in those of art ...'¹⁰¹

As in other presentations of the Argument, the exclusion of *alternatives* to design is an important part of Paley's strategy. The most dangerous alternative, for Paley—since it threatens the basis of the analogy between organisms and artefacts—is the argument that organisms, unlike watches, reproduce themselves, and may have done so throughout an eternal past; to which he replies that an infinite regress of reproduction, though logically possible, fails to explain the appearance of design in the series as a whole: 'A designing mind is neither supplied by this supposition, nor dispensed with'.¹⁰² Early in the *Natural Theology* he also deals incisively with the old Lucretian doctrines,¹⁰³ before dismissing the Humean 'principle of order' as 'a mere substitution of words for reasons, names for causes'.¹⁰⁴ Consideration of alternatives is resumed in the important Chapter 23, where he briskly demolishes Hume's 'principle of generation' and Buffon's 'organic molecules'. And it is here that he deals with the system of appetencies.

The System of Appetencies

Paley introduces the topic as follows: 'Another system, which has lately been brought forward, and with much ingenuity, is that of *appetencies*. The principle and short account of the theory is this: Pieces of soft, ductile matter, being endued with propensities or appetencies for particular actions, would, by

98 *Natural Theology*, ch. 2, p. 12. Similar expressions are used many times.

99 *Natural Theology*, ch. 1, p. 4.

100 If there is one major weakness in Paley's exposition, it is that he takes the empirical identification of purpose or utility, whether in nature or in artefacts, as unproblematic.

101 *Natural Theology*, ch. 7, pp. 88–9. In a stimulating article, Gillespie, N. C. 'Divine design and the Industrial Revolution', *Isis*, (1991), 81, 214–29, has argued that Paley's emphasis on mechanism—amounting to an *identification* of organisms with machines—was intended to appeal to readers in the 'emerging industrial population'. I do not find the evidence for this conclusive, but cannot pursue the point here.

102 *Natural Theology*, ch. 2, p. 13; and ch. 4, pp. 53ff. The form of the 'infinite regress' argument is derived from Wollaston's *Religion of Nature Delineated* (1723), but the use to which Paley puts it may be new.

103 *Natural Theology*, ch. 5, pp. 68–76.

104 *Ibid.*

continual endeavours, carried on through a long series of generations, work themselves gradually into suitable forms; and at length acquire, though perhaps by obscure and almost imperceptible improvements, an organization fitted to the action which their respective propensities led them to exert.¹⁰⁵

Though Paley does not name the *Zoonomia*, there can be little doubt of his principal target. The very description of the doctrine as the system of *appetencies*—a word rare in general usage, yet common in the *Zoonomia*—is the strongest clue. Moreover, Paley expects his readers to follow his allusion to a system 'lately brought forward', implying a degree of notoriety appropriate to Darwin's theories; and it was indeed received as aimed at Darwin.¹⁰⁶

Paley begins his critique by noting certain limitations of Darwin's theory. It does not purport to explain the 'original propensities', but 'ascribes them to the ordination and appointment of an intelligent and designing Creator'.¹⁰⁷ Moreover, the faculty of *reproduction*, 'which is all along assumed and presupposed ... seems to be referred to the same cause; at least is not attempted to be accounted for by any other'. Paley is unwilling therefore to describe it strictly as an *atheistic* scheme. However, it resembles *atheistic* systems in one important respect, namely that it 'dispenses with ... the necessity, in each particular case, of an intelligent, designing mind'. For Paley this is unacceptable.

The first, and most obvious, objection to the theory is a lack of evidence: 'No changes, like those which the theory requires, have ever been observed', and while it may be countered that the process is too slow to be perceived, it remains the fact that evidence is lacking. More interestingly, Paley suggests that the evidence is actually against the inherited effects of use and disuse (or mutilations), pointing out that the breasts of the male have not vanished from lack of use, and Jewish boys are still after many centuries born with foreskins.¹⁰⁸

Paley next turns to consider 'analogies' which have been brought in favour of the hypothesis. For example, the camel's hump or 'bunch' is said to be the inherited effect of carrying burdens since ancient times; secondly, cranes and other wading birds have their thighs bare of feathers as a result of standing thigh-deep in water; and thirdly the throat-pouch of the pelican 'is nothing more, say our philosophers, than the result of habit; not of the habit or effort of a single pelican, or of a single race of pelicans, but of a habit perpetuated through a long series of generations ... These, or of this kind, are the analogies

105 *Natural Theology*, ch. 23, p. 463.

106 *The Edinburgh Review*, (1802–3), 1, p. 301, notes in its review of the *Natural Theology* that 'the appetencies of Dr Darwin are explained and disposed of in this manner...' It should be mentioned that Lamarck had given the first brief exposition of his own evolutionary theory in Paris in 1800, but it is most unlikely that this was yet known in Britain.

107 *Natural Theology*, ch. 23, p. 464–5. It is unclear whether Darwin's invocation of the 'Great First Cause', etc., is more than a smokescreen: see the discussion and citations in Harrison, *op. cit.* (82), pp. 255f. However, we have noted that in the *Temple of Nature* Darwin argues, with apparent conviction, for the existence of a deity, and the evidence on the whole suggests that he remained a deist rather than an atheist.

108 *Natural Theology*, ch. 23, p. 466. Paley's reference to circumcision is veiled in discreet Latin: 'nec curtorum, per multa saecula, Judaeorum propagini deest praeputium'.

relied upon'.¹⁰⁹ I have been unable to find these particular examples anywhere in the work of Erasmus Darwin. This does not mean that they are Paley's inventions, for two of them, at least, can be found in other writers, and all may be part of a common fund of evolutionist motifs.¹¹⁰

Paley finds difficulties in all three cases. Not only is direct evidence lacking, but comparison with other animals raises doubts about the explanations offered: buffaloes have a hump between their shoulders not unlike the camel's, which cannot be explained in the way supposed; immersion in water does not in general eliminate feathers (for example, on the breast of the swan); and no reason is given why the pelican, alone among fish-eating birds, should have acquired a pouch. But Paley's main objection is that these, the strongest examples available, are far from meeting the needs of the theory: 'it is a straining of analogy beyond all limits of reason and credibility, to assert that birds, and beasts, and fish, with all their variety and complexity of organisation, have been brought into their several forms ... by the same process ... as might serve for the gradual generation of a camel's hump, or a pelican's pouch. The solution, when applied to the works of nature *generally*, is contradicted by many of the phenomena, and totally inadequate to others'.¹¹¹

Here we must emphasise that Paley's critique of the doctrine of appetencies is not confined to any single chapter, but is a running theme throughout the *Natural Theology*. By the time he reaches his systematic examination of the doctrine he has already shown in a series of examples the inadequacy of any theory that ascribes adaptations to *effort*, *volition* or the *use of parts*. Paley's examples are briefly described in the Appendix to this article.¹¹²

Cumulatively these cases present a formidable obstacle to the *adequacy* of the theory of appetencies. But Paley also examines more general difficulties. First, the *senses* of animals are beyond the reach of the theory: 'How will our philosopher get at *vision*, or make an eye?... Or suppose the eye formed, would the perception follow?... No laws, no course, no powers of nature which prevail at present, nor any analogous to these, would give commencement to a new sense. And it is in vain to inquire how that might proceed, which could never *begin*.'¹¹³ While the sense organs are the most clearly inexplicable by the hypothesis, other parts of animals are sufficiently so: 'The solution does not apply to the parts of animals which have little in them of motion. If we could suppose joints and muscles to be gradually formed by action and exercise, what action or exercise could form a skull, or fill it with brains?' Nor does the theory

109 *Natural Theology*, ch. 23, p. 469.

110 Buffon's *Natural History* and Goldsmith's *Animated Nature*—both sources familiar to Paley—do account for the camel's hump in the way suggested. The nakedness of wading birds' thighs is not, I think, explained by Buffon in the way described by Paley, but the explanation is hinted at by Goldsmith and more clearly stated by Lamarck, in the *Discours d'Ouverture* of 1800. It may well be found in other writers of the period.

111 *Natural Theology*, ch. 23, pp. 470–1.

112 It is only practical to list those cases where Paley explicitly challenges the theory of appetencies. A list of cases where it *could* be challenged would be almost a recital of the book.

113 *Natural Theology*, ch. 23, p. 472.

explain the external covering of animals: 'No effort of the animal could determine the clothing of its skin. What conatus could give prickles to the porcupine or hedgehog, or to the sheep its fleece?'¹¹⁴ And as a final broad objection, the theory of appetencies has no obvious application to *plants*: 'Yet a no less successful organisation is found in plants, than what obtains in animals. A solution is wanted for one, as well as the other.'¹¹⁵

Paley might well feel satisfied that with these objections the system of appetencies was refuted, in so far as it claimed to be an *adequate* account of organic adaptation. The superficial attraction of the theory was its apparent simplicity in deriving all adaptation from a single mechanism. The theory assumes that adaptation is the inherited residue of the *activity* of organisms or their parts. But this takes too narrow a view of adaptation, which is often passive or even (as in the case of the valves of the heart) contrary to the natural direction of activity. To this objection there seems to be no answer within Erasmus Darwin's philosophy.

Conclusions

The main conclusions of this article may be briefly recapitulated. First, I have suggested that the argument from design became less prominent in the course of the eighteenth century in Britain; not because it had been discredited, but because the threat of atheism was felt to have receded. With the emergence of new atheist threats towards the end of the century, the argument needed to be updated and refreshed. Paley successfully undertook that task.

Whatever the strength of the objections to design, few would reject it without a plausible alternative. No such alternative was available until the 1790s. The traditional options—the eternity of the world in its present state, a principle of order or necessity, and the Epicurean doctrine of chance—had been adequately refuted by many writers. Theories of organic evolution were for various reasons slow to emerge, and did not at first present a serious alternative to design, since they did not explain adaptation.

Erasmus Darwin's theory of evolution, as presented in the *Zoonomia*, changed this. By postulating that organisms gradually mould their form by exertions to meet their needs or 'appetencies', Darwin's theory offered the prospect of explaining adaptation. It was important for defenders of design to counter the threat. Paley did so by demonstrating, with detailed examples throughout the *Natural Theology*, that the system of appetencies was inadequate, since many adaptations actually found in organisms were either passive or resistant to the direction of action.

It is not possible to explore here the subsequent influence of Paley's arguments in the nineteenth century. Samuel Butler, writing towards the end of the century, remarked that 'Paley's *Natural Theology* is written throughout at the

114 *Ibid.*

115 *Ibid.*

Zoonomia, though he is careful, *more suo*, never to mention this work by name. Paley's success was probably one of the chief causes of the neglect into which the Buffonian and Darwinian [sic] systems fell in this country'.¹¹⁶ To explore Butler's hypothesis would take more time and space than I can give it now. I will however close with a suggestion. It has been commonly supposed that Charles Darwin came to rely increasingly on 'Lamarckian' inheritance in his later years, in defence against criticisms of the adequacy of natural selection.¹¹⁷ I do not think this is wholly correct. While Darwin did come to express a somewhat more favourable view of use-inheritance, it was not as a *substitute* for natural selection, but as a co-operative factor working in the same direction. Thus, in the last edition of the *Origin* he notes that 'the inherited effects of the increased use of parts, and perhaps of their disuse, will be strengthened by natural selection ... How much to attribute in each particular case to the effects of use, and how much to natural selection, it seems impossible to decide.'¹¹⁸ Similar remarks are found in the *Descent of Man*.¹¹⁹

Our view of Charles Darwin's shifting position is inevitably coloured by the fact that Lamarckian inheritance has been generally discredited; his later views therefore seem a regrettable 'backsliding'. Yet at all times Darwin had accepted the *possibility* of use-inheritance, as did nearly all of his contemporaries until Weismann's challenge. The question we should ask is not why Darwin spoke more favourably of use-inheritance in his later years, but why he made so little use of it at the outset. In addressing this question, Darwin's close and early familiarity with Paley's critique should not be overlooked.

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116 Samuel Butler, *Evolution Old and New*, 3rd edn., London, (1911).

117 For one out of many possible examples see de Beer, G. *Charles Darwin: Evolution by Natural Selection*. London: Thomas Nelson (1963), p. 175.

118 Charles Darwin, *On the Origin of Species*, 6th edn., (1872), Everyman's Library edn., (1972), p. 213.

119 Charles Darwin, *The Descent of Man, and Selection in Relation to Sex*, (1871), for example vol. I, pp. 143 and 154.

Appendix: Paley's Examples of the 'System of Appetencies'

1. Discussing the tear-duct of the human eye: 'It is easily perceived, that the eye must want moisture: but could the want of the eye generate the gland which produces the tear, or bore the hole by which it is discharged—a hole through a bone?' *Natural Theology*, ch. 3, p. 37.

2. The kneebone is separated from other bones, and produced by 'an ossification, of the inception or progress of which no account can be given from the structure or exercise of the part'. *Natural Theology*, ch. 8, p. 116.

3. The ligament which holds the hip joints in place is immensely strong, yet so flexible as not to impede movement: 'Nothing can be more mechanical; nothing, however subservient to the safety, less capable of being generated by the action of the joint'. *Natural Theology*, ch. 8, pp. 120–1.

4. The tendons attached to the muscles of the foot would, if not constrained, pull away from the angle of the foot every time they are stretched; and accordingly a ligament constrains them: 'There is also a further use to be made of the present example, and that is, as it precisely contradicts the opinion, that the parts of animals may have been all formed by what is called *appetency*, i.e. endeavour, perpetuated and imperceptibly working its way through an incalculable series of generations. We have here no endeavour, but the reverse of it ...' *Natural Theology*, ch. 9, pp. 155–6.

5. On the valves of the heart, which prevent the reflux of blood: 'We may here likewise repeat, what we have before observed concerning some of the ligaments of the body, that they could not be formed by any action of the parts themselves.' After discussing cases, such as the ribs, where the shape of organs *could* conceivably be so explained, Paley points out that 'valves could not be so formed. Action and pressure are all against them ...' *Natural Theology*, ch. 10, p. 174.

6. Of the membrane of the pericardium: 'How could such a loose covering be generated by the action of the heart?' *Natural Theology*, ch. 10, p. 176.

7. Of the epiglottis, which prevents choking: 'There is no room for pretending that the action of the parts may have gradually formed the epiglottis: I do not mean in the same individual, but in a succession of generations. Not only the action of the parts has no such tendency, but the animal could not live.. without it, or with it in a half-formed state'. *Natural Theology*, ch. 10, pp. 192–3.

8. The mouths of quadrupeds and birds might be widened or shaped by continued efforts, but this cannot explain the bird's loss of teeth or acquisition of a horny beak: *Natural Theology*, ch. 12, p. 242.

9. The *strength* of the gullet muscles of grazing animals might be accounted for by exercise, but not their distinctive *arrangement*. *Natural Theology*, ch. 12, p. 244.

10. The semilunar valves of the human intestine, which are supposed to delay the food on its downward passage, are not found in quadrupeds; in both cases they would be formed in direct opposition to pressure, but the resistance is greater in humans because of their upright posture: 'The structure is found where its generation, according to the method by which the theorist would have it generated [i.e., by the action of the parts] is the most difficult; but (*observe*) it is found where its effect is most useful'. *Natural Theology*, ch. 12, pp. 245–6.

11. The bones of birds are hollow for lightness: 'Yet this form could not be acquired by use, or the bone become hollow and tubular by exercise. What agency could excavate a bone?' *Natural Theology*, ch. 12, p. 248.

12. On webbed feet: 'There is nothing in the action of swimming, as carried on by a bird upon the surface of the water, that should generate a membrane between the toes. As to that membrane, it is an exercise of constant resistance.' *Natural Theology*, ch. 12, p. 255.

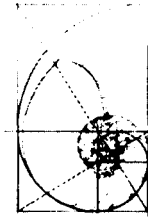
13. On the oil-gland of birds: 'Nothing similar to it is found in unfeathered animals. What blind conatus of nature should produce it in birds? should not produce it in beasts?' *Natural Theology*, ch. 13, p. 261.

14. On the muscles and bones of the marsupial pouch: 'Is there any action in this part of the animal, any process arising from that action, by which these members could be formed?' *Natural Theology*, ch. 13, p. 266.

15. Fishing birds often have beaks or claws with serrated edges, the better to hold slippery fish: 'Nor can the structure of this ... arise from the manner of employing the part. The smooth surfaces, and soft flesh of fish, were less likely to notch the bills of birds, than the hard bodies on which many other species feed.' *Natural Theology*, ch. 13, p. 267.

16. The woodpecker's tongue has a barbed tip to spear insects with: 'If this be not mechanism, what is? Should it be said, that, by continual endeavours to shoot out the tongue to the stretch, the woodpecker species may by degrees have lengthened the organ itself beyond that of other birds, what account can be given of its form, of its tip?' *Natural Theology*, ch. 13, pp. 269–70.

17. On the elephant's trunk, which is essential for drinking: 'If it be suggested that this proboscis may have been produced, in a long course of generations, by the constant endeavour of the elephant to thrust out his nose (which is the general hypothesis by which it has lately been attempted to account for the forms of animated nature.) I would ask, How was the animal to subsist in the mean time, during the process, until this prolongation of snout were completed? What was to become of the individual, while the species was perfecting?' *Natural Theology*, ch. 16, p. 299. (This example was indeed given by Erasmus Darwin: *Zoonomia*, II, p. 238).



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