

In Retrospect

Charles Darwin and his Dublin critics: Samuel Haughton and William Henry Harvey

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This year marks two important anniversaries linked to the life and work of Charles Robert Darwin (Pl. I). He was born on 12 February 1809, and his most influential work, *On the origin of species*, was published late in 1859. Darwin was elected an Honorary Member of the Royal Irish Academy (RIA) at a stated meeting on 16 March 1866.¹ By this time the controversy sparked by his book had begun to die down. The general idea of evolution was gaining wide acceptance, although few scientists as yet regarded Darwin's theory of natural selection as the best explanation of how the process worked.

Darwin certainly had supporters in the RIA, including the geologist Joseph Beete Jukes and the naturalist Robert McDonnell, both of whom were on the Committee of Science in the year he was elected. But two members of the Academy had been prominent critics of Darwin's theory during the early 1860s: Samuel Haughton (Pl. II) and William Henry Harvey, professors of geology and botany respectively at Trinity College Dublin. Both were deeply religious men (Haughton was ordained a Church of Ireland priest in 1847) and their suspicion of natural selection typified the position of many critics who found it hard to accept the theory's tendency to undermine the Christian view of the world as a product of Divine wisdom. Of the two, Haughton was the most vociferous in his opposition and—in Darwin's eyes—the most unfair. His training in the physical sciences made it difficult for him to come to grips with the sort of evidence that Darwin deployed. Harvey was more sympathetic, and engaged in a lengthy correspondence with Darwin in which he tried to define the conditions under which he might accept a limited form of evolution. Their positions thus help us to understand the scale of critical opinion ranged against Darwin and the tactics that he adopted to blunt the force of this opposition. This short retrospect will explore the interactions between them, focusing especially on the reactions to be found in Darwin's correspondence.

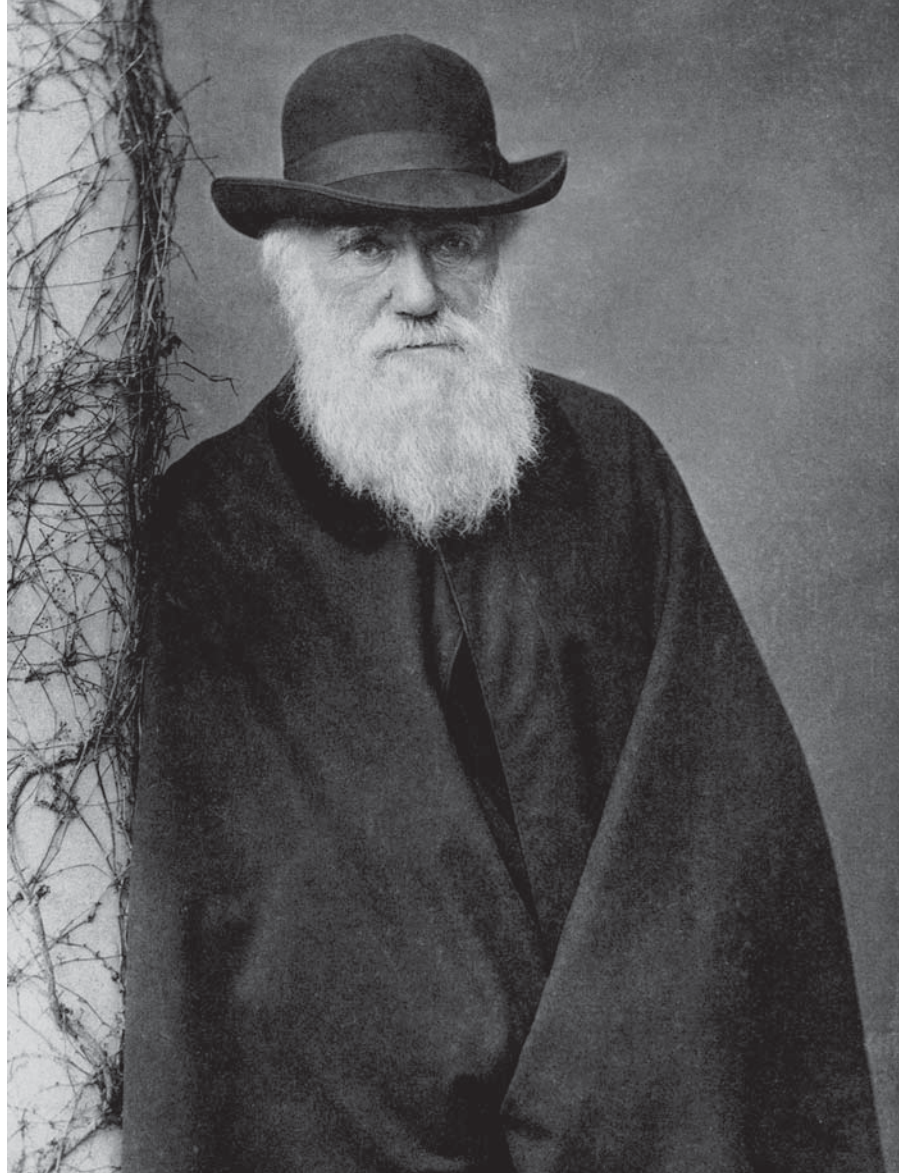
To put the opinions of Haughton and Harvey into context, we need to appreciate that there were two points on which Darwin's theory challenged traditional

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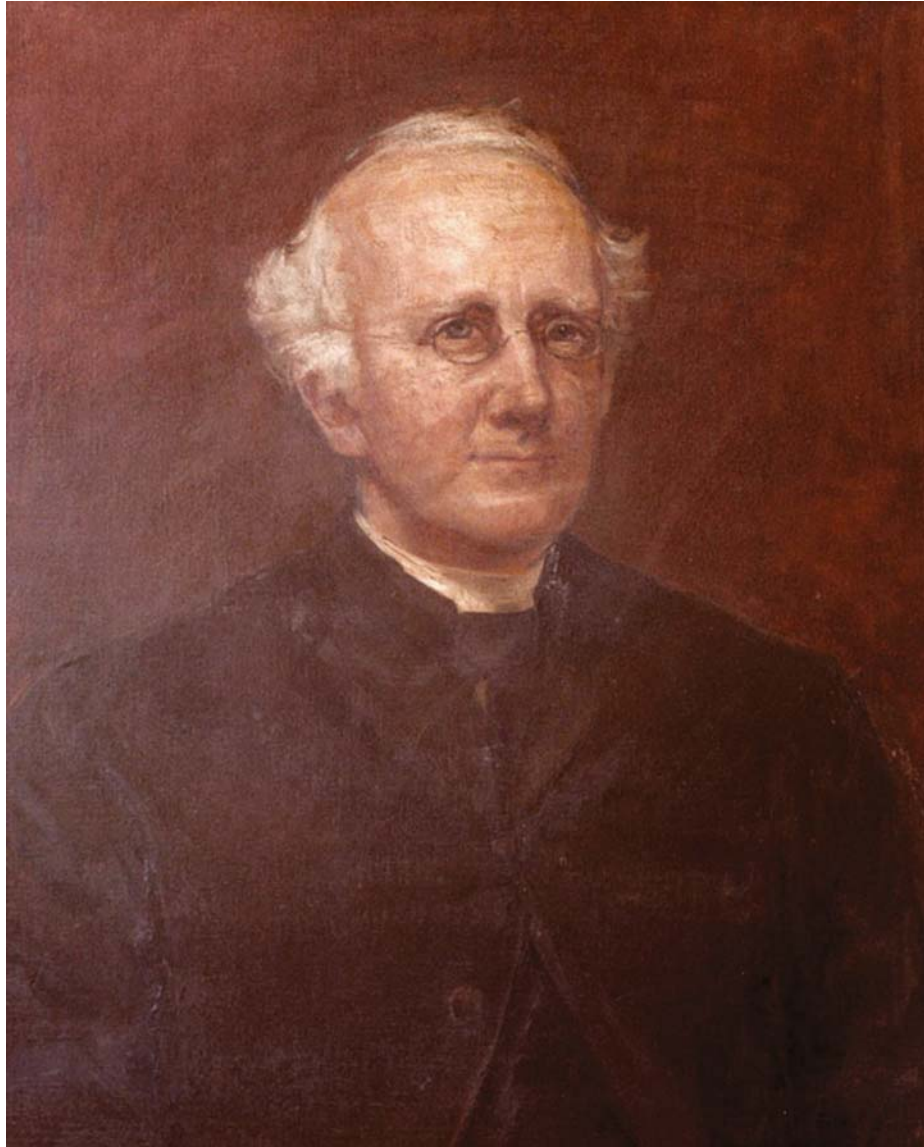
This retrospective piece relates to correspondence between two Royal Irish Academy Members, Samuel Haughton and William Henry Harvey, and Charles Darwin, Hon. MRIA.

¹ See *Proceedings of the Royal Irish Academy* 9 (1864–6), 389. Two other Honorary Members were elected at the same time, Rudolph Clausius and Michel Chasles.



PL. I—Photograph of Charles Darwin, c. 1880.

beliefs. Although the *Origin of species* scarcely mentioned the question of human origins, everyone knew that the theory would imply human descent from an animal ancestry and hence challenge the unique spiritual status accorded to humankind. More directly relevant to the book's topic was the question of design. Traditionally it was argued that the complex structures of living things, and their adaptation to the organisms' lifestyles, were an indication of Divine wisdom and benevolence. Natural selection explained adaptation as the result of a process that was little more than trial and error. Populations exhibited a range of apparently undirected variation; those variants which happened to have some adaptive advantage survived and bred,



Pl. II—Portrait of Reverend Samuel Haughton painted by Sarah Henrietta Purser. Haughton was president of the Royal Irish Academy between 1886 and 1891. © Royal Irish Academy.

those which were harmful were killed off in the ‘struggle for existence’ which was an inevitable consequence of the pressure of population on limited resources.

For critics steeped in the logic of the ‘argument from design’ it was hard to see how such a haphazard process could mimic the effects of Divine wisdom. Haughton represents a conservative position, initially rejecting any form of evolution as incompatible with design. But in the case of Harvey we see a scientist who could appreciate the evidence favouring some form of evolution and grappling with the problem of how to retain a role for Divine purpose within such a system. Many late nineteenth-century thinkers—including scientists—accepted evolution only on

the understanding that something more purposeful than natural selection was the main driving force.² Some, like the American botanist Asa Gray, modified the selection theory by supposing that God had somehow programmed the laws governing variation to generate more adaptive than maladaptive characters. Harvey's arguments suggest that he too would be more willing to accept the theory if some element of design could be retained.

Samuel Haughton

In 1851 Samuel Haughton (1821–97) was appointed professor of geology at Trinity College Dublin but he also had much wider scientific interests. He had a passion for calculation, which he applied to estimations of the age of the earth, supporting, but later opposing, the very limited timescale suggested by William Thomson, Lord Kelvin.³ At the time he was coming to grips with Darwinism, he was working toward a medical degree (he qualified in 1862) to acquire skill in anatomy. He served as registrar of the Dublin Medical School and published on medical topics including the effect of poisons. Using his training in anatomy, he studied the mechanical principles underlying the functioning of animal bodies. When Darwin was elected an Honorary Member of the RIA in 1866, Haughton was reading a series of papers on this topic to the Academy, later collected in his *Principles of animal mechanics* of 1873. As an ordained clergyman he would naturally have had concerns about the implications of Darwin's theory for both human origins and the argument for design. In the latter area he clearly felt that his biological interests made him qualified to comment on the scientific adequacy of Darwin's explanation of how adaptive structures were formed.

Haughton has the dubious honour of being the first person to comment on Darwin's theory when the joint papers of Darwin and Alfred Russel Wallace were read to the Linnaean Society of London in 1858. They were presented by Darwin's close allies, the geologist Charles Lyell and the botanist Joseph Dalton Hooker. Haughton presumably saw the printed version of the papers and attacked the theory briefly in remarks made to the Geological Society of Dublin on 9 February 1859. These were reported in the society's journal, and a clipping of this found its way into Darwin's possession. Haughton wrote:

This speculation of Mess. Darwin and Wallace would not be worthy of note were it not for the weight of authority of the names under whose auspices it

² For general accounts of the reaction to Darwin's theory see Peter J. Bowler, *The eclipse of Darwinism: anti-Darwinian evolution theories in the decades around 1900* (Baltimore, 1983) and *The non-Darwinian revolution: reinterpreting a historical myth* (Baltimore, 1988). More generally Peter J. Bowler, *Evolution: the history of an idea* (3rd edn., Berkeley, 2003). Greta Jones discusses Haughton and Harvey briefly in her 'Darwinism in Ireland', in David Attis (ed.), *Science and Irish culture* (Dublin, 2004), 115–38. Miguel DeArce of Trinity College is also working on Darwinism in Ireland, and I thank him for allowing me to see a draft of his work.

³ Haughton's work on the age of the earth is described in Joe D. Burchfield, *Lord Kelvin and the age of the earth* (New York, 1975), 100–3.

has been brought forward. If it means what it says, it is a truism; if it means anything more, it is contrary to fact.⁴

Darwin later commented in his autobiography that this was the only response to the papers, summarising Haughton's verdict as 'all that [was] new in there was false, and what was true was old'.⁵

When the *Origin of species* was published, Haughton weighed in with one of the first and the most critical reviews. This was entitled 'Biogenesis' and appeared originally in the *Natural History Review* in 1860, with an abridged reprint in the *Annals and Magazine of Natural History* for 1863.⁶ Haughton again referred to the theory as a speculation, comparing it at length to the earlier ideas of the Comte de Buffon and Jean-Baptiste Lamarck. The latter had expressed contempt for humankind, and Darwin had merely revived his theory with some borrowings from T.R. Malthus on population. The public interest in the theory was no more significant than that expressed for Mesmerism and table-turning. Haughton insisted that the variation within species was not unlimited, as shown by the fact that there had been no visible changes since humans began leaving records over 3,000 years ago. His most detailed argument focused on a specific point mentioned very briefly in the *Origin of species*, the evolution of the cells within beehives. On the assumption that Darwin's theory predicted a steady increase in the efficiency with which wax is used, he constructed a series of real and hypothetical stages of development and pointed out that the least efficient form was a species still living.

On 30 April 1860 Darwin noted in a letter to Hooker that 'Haughton has been down on us with full force'.⁷ Writing again on 5 June he made it clear that he did not think the review was a fair one:

Have you seen Haughton's coarsely-abusive article of me in *Dublin Mag. of Nat. History*? . . . I never knew anything so unfair as in discussing cells of Bees, his ignoring the case of *Melipona*, which builds combs almost exactly intermediate between *Hive* and *Humble-bee*. What has Haughton done that he feels so immeasurably superior to all us wretched naturalists and to all political economists, including the great philosopher Malthus?⁸

⁴ From the notice enclosed in the letter from Darwin to J.D. Hooker, 3 May 1859, in Frederick Burkhardt and Sydney Smith (eds), *The correspondence of Charles Darwin, 7 (1858–9)* (Cambridge, 1991), 292.

⁵ Nora Barlow (ed.), *The autobiography of Charles Darwin, with the original omissions restored* (New York, 1958), 122.

⁶ Samuel Haughton, 'Biogenesis', *Natural History Review* 7 (1860), 23–32, reprinted in David L. Hull (ed.), *Darwin and his critics: the reception of Darwin's theory of evolution by the scientific community* (Cambridge, MA, 1973), 216–28.

⁷ In Frederick Burkhardt *et al.* (eds), *The correspondence of Charles Darwin, 8 (1860)* (Cambridge, 1993), 181.

⁸ Burkhardt *et al.*, *Correspondence of Darwin, 8*, 238. For the original discussion of bee-cells see Charles Darwin, *On the origin of species by means of natural selection* (London, 1859), 224–35.

Darwin repeated the same points in letters to Charles Lyell on 6 June and to Asa Gray two days later. He was particularly annoyed about the argument based on bee-cells, a point mentioned only briefly in the *Origin of species* because the cells built by *Melipona* offered such a good example of an intermediate stage in the development of the cell-building technique. Haughton's series of intermediates was completely hypothetical, used to allow him to make a mathematical calculation of how efficiently the wax was being used. When Haughton's review was reprinted in 1863, Alfred Russel Wallace wrote a short response to his argument about the bee-cells.⁹ In Darwin's view Haughton's argument was an example of a mathematician dismissing the sort of evidence used by naturalists. The letter to Gray makes the point explicitly: Haughton's argument 'shows immeasurable contempt of all who are not mathematicians'.¹⁰ In his commentary on Haughton's review, David Hull notes that his response to the theory of natural selection was typical of many other scientists with a mathematical training, including William Thomson.¹¹

Darwin was prepared to admit that his explanation of natural selection had not enabled his critics to understand how the process was supposed to work. But was this due to his own inability to explain the concept clearly, or to the strength of the critics' preconceptions? His letter to Hooker of 5 June refers to both Haughton and Harvey and suggests that their critiques have convinced him 'that I must be a very bad explainer. Neither really understands what I mean by natural selection—I am inclined to give up the case as hopeless—those who do not understand, it seems, cannot be made to understand'.¹² Darwin suspected that those whose view of nature was dominated by the concept of design and purpose would find it very difficult to see a mechanism based on trial-and-error as adequate to explain the phenomena. He made no effort to convince Haughton privately and there seems to have been no direct contact between them.

Haughton's ongoing work on animal mechanics placed him firmly in the camp of those who believed that each species' structure was so well-engineered that it must reflect intelligent design by the Creator. The basic postulate stated in his 1873 book on the topic was that the 'Framer of the Universe' had constructed all muscles so that they could do the maximum amount of work in the circumstances in which they operate.¹³ In the preface he conceded that it made no difference if the contrivance was arranged directly by the Creator or was the indirect product of some former condition, as foreseen by Him. In the latter situation we would say that it 'evolved out of its former state, but in such an Evolution there was nothing left to Chance; it was all foreseen, and the Evolution itself presided over by the Divine Mind that planned the whole'. He now saw no reason why there might not be such a process of

⁹ Alfred Russel Wallace, 'Remarks on the Rev. S. Haughton's paper on the bee's cell, and on the origin of species', *Annals and Magazine of Natural History* 12 (1863), 303–9.

¹⁰ Darwin to Asa Gray, 8 June 1860, in Burckhardt *et al.*, *Correspondence of Darwin*, 8, 247.

¹¹ Hull, *Darwin and his critics*, 228.

¹² Burckhardt *et al.*, *Correspondence of Darwin*, 8, 238.

¹³ Samuel Haughton, *The principles of animal mechanics* (London, 1873), 238.

‘Teleological Evolution’ at work, but insisted that ‘The Laws of such an Evolution appear to me, in the present state of knowledge, to be entirely unknown’.¹⁴

Darwin’s theory fairly obviously did not fit the bill, a point made clear in a brief comment included in a section on the process of giving birth, where Haughton considered how the muscles of the uterus must be able to exert enough pressure to rupture the membranes so that the baby can emerge, without destroying themselves. The system was, in fact, perfectly designed to do this, but on the ‘Lamarckian Theory of Natural Selection’ we are all the lucky descendants of females who acquired the correct balance accidentally and thus gained an advantage in the competition for life. Harking back once again to the efficiency of the bees’ use of wax, Haughton made it perfectly clear that he did not think natural selection could explain such a level of efficiency.¹⁵ He approached anatomy through an abstract analysis based on geometry, ‘the Queen of the Sciences’, and the laws of mechanics, on the assumption that natural structures always work in the most efficient way, a procedure he justified with a reference to Plato.¹⁶ It is hardly surprising that Haughton found it hard to appreciate Darwin’s vision of species as populations of varying individuals constantly having to make adaptive compromises to cope with multiple constraints imposed by a complex and ever-changing environment.

William Henry Harvey

Harvey was a different matter: here was an experienced naturalist used to handling the same kind of evidence as Darwin himself, although he was described by Leonard Huxley as a systematist rather than a generaliser.¹⁷ William Henry Harvey (1811–66) was a specialist in marine algae who had made extensive collections of plants in southern Africa while he was Colonial Treasurer in Cape Town from 1836 to 1842. He was appointed keeper of the herbarium at Trinity College Dublin in 1844 and professor of botany in 1856. He travelled extensively in Sri Lanka, Australia and the Pacific islands to collect plants and was on good terms with Joseph Hooker, who took him to visit Darwin at Down House in August 1858.¹⁸ He was a deeply religious man, and his objections to Darwin’s theory openly raised the theological issues that were only implicit in Haughton’s critique.¹⁹ Harvey seems to have been willing to make some concessions to evolution theory, so long as he could preserve an element of creative design in the system. Darwin and Harvey exchanged a number of long letters, trying to thrash out the differences between them.

¹⁴ Haughton, *Animal mechanics*, vi.

¹⁵ Haughton, *Animal mechanics*, 158–9. Haughton considered death as well as birth—this book also includes his famous calculation of the most efficient drop to be used when hanging a condemned criminal, see the ‘Digression on the art of hanging’, Haughton, *Animal mechanics*, 8–13.

¹⁶ Haughton, *Animal mechanics*, 485.

¹⁷ Leonard Huxley (ed.), *The life and letters of Sir Joseph Dalton Hooker* (2 vols, London, 1918), vol. I, 515.

¹⁸ This visit is recorded in Burkhardt and Smith (eds), *Correspondence of Darwin*, 7, 178, note 4.

¹⁹ Leonard Huxley makes the point that Harvey’s response was conditioned by ‘religious metaphysics’, see Huxley, *Life and letters of Hooker*, 515.

Harvey received a copy of the *Origin of species* early in 1860 but put it aside while he was still heavily engaged in teaching. He did, however, write a note to the *Gardeners' Chronicle* pointing to the appearance of a sport in *Begonia* which seemed to imply that major new characters could appear by saltation (sudden leaps) rather than by gradual increments. Hooker responded to this, and they began to correspond about Darwin's theory, with Harvey querying some details about the extent of variation in primroses.²⁰ He also wrote a 'serio-comic squib' about the implications of the theory for human origins which was originally presented at the Dublin University Zoological and Botanical Association and which, apparently, his friends thought rather unworthy of the occasion.²¹ He later sent a copy of this to Darwin 'with the writer's repentance'.²² In the meantime, Hooker urged him to approach the issue in the spirit of looking for some generalisation that would show progress after 30 years of fruitless debate over the nature of species. On 26 May 1860 Hooker expressed the hope that they would be able to come to some agreement about the legitimacy of the line of investigation that Darwin had opened up. He acknowledged that there was a middle way between creation and gradual evolution represented by the theory of evolution by saltation, but indicated that he could see no reason to support it.²³ Harvey expressed his objections to the theory of natural selection in a letter to Hooker which has not survived, but apparently made it clear that he was not totally opposed to the idea of transmutation. Hooker sent Harvey's letter to Darwin so that he could respond directly.

On 29 May 1860 Darwin told Hooker that he would write to Harvey and try to clarify the theory of natural selection by explaining the analogy with domestic productions.²⁴ The following day he returned Harvey's letter, expressing relief that there was no evidence of bigotry in Harvey's reaction and that he seemed to go 'a little way (*very much* further than I supposed) with us on Nat. Selection'.²⁵ At this point Harvey's reaction was based mainly on Hooker's information about the theory, and it was only in the summer vacation of 1860 that he finally read the *Origin of species*. He wrote a long letter to Darwin on 24 August, admitting that his opinions had been modified. Although he could not accept the theory of natural selection as a satisfying explanation of the origin of species, he realised that it did explain many facts which were otherwise difficult to account for.²⁶ Without knowing more about the 'Variation and Correlation of Organs', he could only regard natural selection as one agent

²⁰ Letter from Hooker to Harvey, 1860, Huxley, *Life and letters of Hooker*, 515.

²¹ The comment about the reaction is Leonard Huxley's, Huxley, *Life and letters of Hooker*. Harvey's 'squib' was privately printed as a pamphlet entitled *An inquiry into the probable origin of the human animal, on the principle of Mr. Darwin's theory of natural selection, and in opposition to the Lamarckian notion of a monkey parentage* (Dublin, 1860).

²² See the letter from Harvey to Darwin, 8 October 1860, in Burckhardt *et al.*, *Correspondence of Darwin*, 8, 421.

²³ Huxley, *Life and letters of Hooker*, 517–19.

²⁴ Burckhardt *et al.*, *Correspondence of Darwin*, 8, 230.

²⁵ Darwin to Hooker, 30 May 1860, Burckhardt *et al.*, *Correspondence of Darwin*, 8, 231–2.

²⁶ Burckhardt *et al.*, *Correspondence of Darwin*, 8, 322.

among several. This was an extremely common response to the theory, paralleling that of Houghton. We have already seen how Houghton's reaction convinced Darwin that he had to work hard to convince his critics that although he could not explain the origin of variation, the theory offered a valid explanation of adaptive change as long as it was accepted that there is a plentiful supply of undirected variation in every population.

Harvey found some of Darwin's examples unconvincing, noting that the suggestion that a bear swimming with its mouth open to catch flies might represent the first stage in the evolution of whales 'simply made me laugh'.²⁷ On the other hand, the later chapters of the *Origin* on the succession and distribution of forms did weigh more heavily on his mind. He had always supposed that many acts of creation had been required to establish the main groups of life, with closely related species then being produced by natural variation within well-defined limits. He noted that Darwin allowed the possibility of four or five original progenitors for life on earth, and suggested that this meant they were only disagreeing over the number of creations. Since Darwin had himself indicated that life had first been given by the Creator, neither of them were infidels. Darwin had, indeed, tried to distance his theory from the controversial issue of the spontaneous generation of life by using the biblical language of life being 'breathed' into the first forms, although he later told Hooker that he regretted having truckled to popular opinion on this point.²⁸ Harvey's reaction reveals how sensitive an issue this was for some readers. He was also concerned about the amount of change that would have been needed to form the progenitors of the main animal groups from a primordial protozoon, especially as it was likely that the rate of change among primitive creatures was very slow. This made the idea of a single original form much less plausible, and if one supposed that the Creator had acted once, why not more often? Evolution in the earliest forms would have to be controlled by 'Unknown Laws of Variation' or they would be 'doomed to perennial sameness'.²⁹ These laws probably acted through saltations or sports, and represented the same kind of supernatural Power as the original Creation, an 'Everlasting, Superintending, Upholding and Continuing Intelligence' providing evidence of a Great Design. Again, Harvey expresses the hope that Darwin himself would not deny the involvement of the First Cause. In his eyes, the laws of variation were simply expressions of the 'superintending and moulding Intelligence' which might act either directly or through laws.

These last remarks went to the heart of the issue which divided Darwin from many of his contemporaries, even supporters such as Asa Gray. Gray had begun by trying to argue that natural selection was compatible with design, although in

²⁷ Burckhardt *et al.*, *Correspondence of Darwin*, 8, 323. See Darwin, *On the origin of species*, 184.

²⁸ Darwin to Hooker, 29 March 1863, in Frederick Burckhardt *et al.* (eds), *The correspondence of Charles Darwin*, 11 (1863) (Cambridge, 1999), 278. For the original comment see Darwin, *On the origin of species*, 490.

²⁹ Harvey to Darwin, 24 August 1860, Burckhardt *et al.* (eds), *Correspondence of Charles Darwin*, 8, 328.

the end he suggested that the laws of variation were somehow programmed by the Creator to ensure that appropriate new characters appeared in the course of each species' evolution.³⁰ Darwin's response to both Gray and Harvey was to urge caution over the assumption that design could somehow be built into the laws of nature. If variation were directed toward appropriate ends, what was the point of natural selection? His theory was based on the observation that species exhibit a wide range of undirected variation, which is precisely why selection is needed to weed out the unfit characteristics and boost the reproduction of the fittest (i.e. best adapted). Harvey himself had admitted in his first letter that he found Darwin's case for 'the law of the strongest' and his insistence that the 'weakest go to the wall' perhaps the best established part of the theory, yet he was apparently unable to see selection as a process capable of generating adaptive characters without some superintending design.³¹

In a letter, written in September 1860, Darwin urged Harvey to think more carefully about the claim that natural selection was no more than the 'order of nature', although he admitted the difficulty of explaining the theory and suggested that the term 'selection' had misled many readers.³² Perhaps 'natural preservation' would have been better. He noted that many fellow-scientists including Hooker and Gray had accepted that natural selection was a real effect, so the theory was not just a statement of the obvious, and directed Harvey to Gray's discussion of the theological implications of the theory. Darwin also insisted that he did not claim that natural selection was the only mechanism at work.

In response Harvey objected to the assumption of 'unlimited' variability in species. He thought that the normal level of variation was a mere oscillation centred on the basic type, so that any modification by selection would only be temporary and reversible.³³ There was much wider variability in some plant species than in others. Returning to the subject of the hypothetical original protozoon, he asked why some of its descendants had evolved into higher types while others had remained at the same level. Again he insisted that saltations would be needed to introduce new types.³⁴

This seems to have been the last direct contact between Darwin and Harvey, although the latter eventually published a review of the *Origin of species* in the *Dublin Hospital Gazette* in May 1861.³⁵ Darwin commented on this to Hooker on

³⁰ Gray's articles defending Darwin's theory and examining its theological implications were collected in his *Darwiniana: essays and reviews pertaining to Darwinism* (New York, 1876). For the comments implying that variation is somehow biased to produce favourable characters, see 148.

³¹ Harvey to Darwin, 24 August 1860, Burkhardt *et al.* (eds), *Correspondence of Charles Darwin*, 8, 329–30.

³² Darwin to Harvey, 20–4 (*sic.*, probably 24) September 1860, Burkhardt *et al.* (eds), *Correspondence of Charles Darwin*, 8, 370–5.

³³ Harvey to Darwin, 8 October 1860, Burkhardt *et al.* (eds), *Correspondence of Charles Darwin*, 8, 415–6.

³⁴ Burkhardt *et al.* (eds), *Correspondence of Charles Darwin*, 8, 420.

³⁵ William Henry Harvey, 'On "Omne Vivum ex Ovo", or, the natural evolution of organic species considered', *Dublin Hospital Gazette*, 15 May 1861.

13 July, indicating that he thought it was a good review and expressing surprise at Harvey's appeal to the Bible in support of the general idea of evolution. Harvey had been impressed by the fossil evidence for the succession of species within particular groups such as the horse family, and he asked which was more probable—that God had allowed ancient species to die out completely, and then replaced them by miraculously creating closely related forms, or that the later species were somehow modified descendants of the earlier ones. Appealing to the story of Noah's flood, he saw God's preservation of Adam's line through the catastrophe as an indication that a similar continuity would explain the succession of fossil species. Darwin told Hooker, 'I never expected to get a helping hand from the Old Testament'.³⁶

Harvey suffered bouts of illness through the early 1860s and died on 15 May 1866, two months after Darwin was elected an Honorary Member of the Academy. Hooker told Darwin the news in words which indicate the depth of his feelings:

I shall never see his like again:—for purity of Spirit and sweetness of Temper he was equalled only by Henslow [Darwin's Cambridge mentor, and Hooker's father-in-law] A more unassuming or unselfish man never lived, and when I think how much purer and better he was than I am I smite my self reproaching conscience and feel stricken with shame and sorrow, almost with remorse.³⁷

Unlike Houghton, Harvey could appreciate the various lines of evidence that Darwin had outlined in favour of the general idea of evolution. Hooker had obviously played an important role in persuading him to think carefully about the facts of species distribution both in space and time. But like many of his contemporaries Harvey found it difficult to see how a process such as natural selection, which drew its raw material from undirected individual variations, could produce the adaptations traditionally seen as evidence of Divine providence. His religious faith made it necessary for him to believe that the natural world was under the direct control of the Creator, and this left him willing to accept that the major steps in the development of life on earth might require direct Divine intervention, even if the subsequent unfolding of each type was produced by natural law. But the really crucial difference between Harvey and Darwin was that for Harvey even the laws governing variation would have to be seen as expressions of the Divine will, and hence might involve providential trends supplying species with the new characters they needed to adapt to their environment, perhaps by sudden saltations. Even more explicitly than Asa Gray, his concept of natural law included an element of premeditated design, whereas for Darwin the very fact that everyday variation could be seen to be more or less undirected made it necessary for there to be a selective effect by the environment.

³⁶ Darwin to Hooker, 13 July 1861, in Frederick Burkhardt *et al.* (eds), *The correspondence of Charles Darwin, 9 (1861)* (Cambridge, 1994), 202.

³⁷ Hooker to Darwin, 17 May 1866, in Frederick Burkhardt *et al.* (eds), *The correspondence of Charles Darwin, 14 (1866)* (Cambridge, 2004), 180–1.

Darwin's vision of evolution made no room for an element of Divine providence. Selection was directed solely by whatever gave an immediate advantage to individual organisms in their struggle to cope with the local environment—it could not plan ahead and it had no long-term goal, least of all a goal with any ethical implications. Thus Darwin was quite willing to see the production of parasites as a typical consequence of the way nature operates. He now found it very hard to believe that there was a wise and benevolent Creator directing the process of evolution, and he was not serious when he implied that even the very first living things were miraculously created. But for many of his contemporaries, it was simply unthinkable that blind nature, driven by a ruthless process such as natural selection, could produce the complex world we live in. Harvey's efforts to retain an element of design within an evolutionary framework parallel the better-known efforts of Asa Gray in America and are typical of how late nineteenth-century culture accommodated the general idea of evolution. Natural selection was sidelined as a process for getting rid of the occasional failures, while progressive evolution was assumed to be driven by more purposeful trends. The story of late nineteenth-century evolutionism is, in fact, the story of a search for natural processes which would embody the kind of purposeful activity envisioned by Harvey.³⁸ Only in the twentieth century would natural selection come into its own, as the new science of genetics undermined the plausibility of these alternatives to natural selection.

³⁸ For details of these alternative theories, which included the Lamarckian theory of the inheritance of acquired characteristics, see Bowler, *The eclipse of Darwinism*.