

DARWIN'S SHADOW:  
CONTEXT AND RECEPTION IN THE WESTERN WORLD

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Emerging from a particular European context, Darwin's ideas have influenced all parts of the world. Two hundred years after his birth, Darwin continues to cast a long shadow over fundamental beliefs and concepts of a large number of people. Many religious scholars have devised ways to accommodate Darwinism into their religious beliefs. These include religious scholars of all three monotheistic religions, for whom the notion of God is a central tenet, even though Darwinism appears to render superfluous the very notion of a Creator as conceived in this tradition.

Supported by famous scientists, a multi-million dollar Darwin industry has emerged in the wake of Darwin's 1859 influential book, *On the Origin of Species*. Not only modern biology, founded on Darwinian and neo-Darwinian theories, but also several other disciplines—such as anthropology, sociology, anatomy, geology, and history—have been affected by Darwinism.

This is the first of a three-part article on Darwin, natural selection, neo-Darwinism, and the philosophical and religious responses to these ideas. It focuses on the emergence of Darwinism and surveys Darwin's reception in the West. Part II will deal with Darwin's reception in the Muslim world and part III will examine Darwinism and neo-Darwinism from an Islamic perspective.

**Keywords:** Darwin; evolution; natural selection; Darwin's religious beliefs; history of science; nineteenth century science; biology; philosophy of science; science and religion.

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### **Introduction**

On the afternoon of July 1, 1858, Charles Lyell (1797-1875) and Joseph Dalton Hooker (1817-1911), two friends of a forty-nine-old man who had lost faith in the Bible,<sup>1</sup> presented two papers at a meeting of the Linnean Society of London.<sup>2</sup> Both papers related to “the Laws which affect the Production of Varieties, Races, and Species”<sup>3</sup> and contained “the results of the investigations of two indefatigable naturalists, Mr. Charles Darwin and Mr. Alfred Wallace.”<sup>4</sup>

In their introductory note to the papers, Lyell and Hooker said:

These two gentlemen having, independently and unknown to one another, conceived the same very ingenious theory to account for the appearance and perpetuation of varieties and of specific forms on our planet, may both fairly claim the merit of being original thinkers in this important line of inquiry; but neither of them having published his views, though Mr. Darwin has for many years past been repeatedly urged by us to do so, and both authors having now unreservedly placed their papers in our hands, we think it would best promote the interests of science that a selection from them should be laid before the Linnean Society.<sup>5</sup>

While it is true that, despite an attempt to prove otherwise,<sup>6</sup> Charles Robert Darwin (1809-1882) had, in fact, conceived the idea of natural selection independently and as early as 1839,<sup>7</sup> nevertheless, “Hooker and Lyell—Darwin’s friends, both of whom were powerful and well-born members of the Royal Society—took action to protect Darwin’s ‘priority.’”<sup>8</sup> Thus popular view would associate only Darwin’s name with the idea of natural selection and Wallace would fade out of picture, but at the time Darwin received Wallace’s paper,<sup>9</sup> he was horrified to see that another person had taken precedent over him and had expressed what he thought was his “big idea” and “original contribution to science”.<sup>10</sup>

Lyell and Hooker had arranged the reading of the two papers at the July 1, 1858 meeting of the Linnean Society in such a way that Wallace’s paper acted as

a sort of coda to Darwin’s. Wallace, still in the Tropics, did not even know about the meeting—nobody told him until it was all over. When he found out, he expressed the humble satisfaction of a servant invited to eat at the master’s table, writing to his mother, “I sent Mr. Darwin an essay on a subject on which he is now writing a great work. He showed it to Dr. Hooker and Sir C. Lyell, who thought so highly of it that they immediately read

it before the Linnean Society. This assures me the acquaintance and assistance of these eminent men on my return home.” One wonders what he might have written had he known the reason for such speedy publication. But later, when he had divined more of the circumstances, he retained his generosity, adding only that he wished he had been given a chance to proof his article.<sup>11</sup>

This meeting of the Linnean Society<sup>12</sup> would subsequently be called the beginning of the “Darwinian Revolution”, “the beginning of modern biology”, “the beginning of a new era in scientific thinking”, and by many other similar phrases, but the actual event was “second only to the presentation of Mendel’s discovery of the laws of genetics as an historical non-event”.<sup>13</sup>

Darwin’s own later recollection of the meeting was more realistic:

The circumstances under which I consented at the request of Lyell and Hooker to allow of an extract from my MS., together with a letter to Asa Gray, dated September 5, 1857, to be published at the same time with Wallace’s Essay, are given in the *Journal of the Proceedings of the Linnean Society*, 1858, p. 45. I was at first very unwilling to consent, as I thought Mr Wallace might consider my doing so unjustifiable, for I did not then know how generous and noble was his disposition. The extract from my MS. and the letter to Asa Gray had neither been intended for publication, and were badly written. Mr Wallace’s essay, on the other hand, was admirably expressed and quite clear. Nevertheless, our joint productions excited very little attention, and the only published notice of them which I can remember was by Professor Haughton of Dublin, whose verdict was that all that was new in them was false, and what was true was old. This shows how necessary it is that any new view should be explained at considerable length in order to arouse public attention.<sup>14</sup>

The reading of the paper, however, compelled Darwin to “set to work” in September 1858,

by the strong advice of Lyell and Hooker to prepare a volume on the transmutation of species, but was often interrupted by ill-health, and short visits to Dr. Lane’s delightful hydropathic establishment at Moor Park. I abstracted the MS. begun on a much larger scale in 1856, and completed the volume on the same reduced scale. It cost me thirteen months and ten days’ hard labour. It was published under the title of the *Origin of Species*, in November 1859. Though considerably added to and

corrected in the later editions, it has remained substantially the same book.

It is no doubt the chief work of my life.<sup>15</sup>

### **On the Origin of Species**

The “chief work” of Darwin’s life, his “big book”, *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*, was published in November 1859,<sup>16</sup> and it immediately generated much interest, controversy, and even fury. It initiated one of the largest public domain publishing ventures—the Darwin Industry—a multi-million dollar enterprise that continues to thrive. In time, Alfred Russel Wallace (1823–1913) was pushed out of the picture<sup>17</sup> and Darwin held center stage—a position that he continues to hold one hundred and fifty years after the publication of his book.<sup>18</sup>

Darwin was “infinitely pleased & proud at the appearance of my child”, as he wrote to his publisher, John Murray, on November 2, 1859.<sup>19</sup> He also sent a copy to James Dwight Dana (1813-1895), an American geologist and zoologist, one of the editors of the *American Journal of Science and Arts* (from 1840), and professor of geology at Yale University (since 1849). Dana had recently published his belief in the fixity of species. Fearing that Dana would be “horrified”, Darwin preempted his reading:

I know too well that the conclusion, at which I have arrived, will horrify you, but you will, I believe & hope, give me credit for at least an honest search after the truth... I hope that you will read my Book, straight through; otherwise from the great condensation it will be unintelligible. Do not, I pray, think me so presumptuous as to hope to convert you; but if you can spare time to read it with care, & will then do what is far more important, keep the subject under my point of view for some little time occasionally before your mind, I have hopes that you will agree that more can be said in favour of the mutability of species, than is at first apparent. It took me many long years before I wholly gave up the common view of the separate creation of each species.

Believe me, with sincere respect & with cordial thanks for the many acts of scientific kindness which I have received from you,  
| My dear Sir | Yours very sincerely | Charles Darwin<sup>20</sup>

### **The Context: Europe and America**

Neither Darwin nor his book emerged in a vacuum; in a way, they were

the most logical outcome of a process that had started with the Scientific Revolution of the seventeenth century—a revolution native to Europe, but which would affect the rest of the world in ways no one could have imagined at that time. Just as the ideas and products of the European Scientific Revolution would soon reach the rest of the world and affect it in numerous ways, Darwin and his theory would also arrive in other civilizations and initiate debates that continue to generate heated arguments.

Darwin, Wallace, and other nineteenth-century naturalists emerged from and affected a very specific scientific, philosophical, and religious milieu that had evolved in Europe over the previous two centuries. By the time Darwin appeared on the scene, science had carved out a niche for itself within the general flow of Western civilization and had attained such authority that its precepts, ideas, and formulations were readily accepted by general public. Thus behind Darwin's bold assertion lay two hundred years of scientific achievements of men like Nicolaus Copernicus (1473-1543), Galileo Galilei (1564-1642), Johannes Kepler (1571-1630), Isaac Newton (1642-1727), Luigi Galvani (1737-1798), Carl von Linné better known as Linnaeus (1707-1778), Antoine Lavoisier (1743-1794), William Herschel (1738-1822), as well as powerful inventions like the telescope and the steam engine, and transforming discoveries like the gravitational force and theories of planetary revolutions.

By the time Darwin appeared on the scene, science had already gone through a fundamental break with the traditional view of the universe and had started to conceive it as an entity that could be perceived, measured, explained, and mathematized. The universe operated like a clock. God was the maker of this clock, but after having made it and set its rules, He did not interfere in its working. This clockwork universe could thus be dissected, observed, understood, and utilized. This view went back to Copernicus, who was enormously affected by a zeal for mathematization of the universe during his student days at Bologna; the triumph of his astronomical theory only served to accelerate the process of mathematization of the physical universe. The Copernican principle that states that the Earth is not in a central, specially favored position was not merely a principle of cosmology; it implied, by extension, a dramatic revision of another concept: that humans were not privileged observers of the universe. By the time of Darwin, this revision had become an essential part of that cosmological principle.

Kepler had wavered between transcendental Platonism and a flattened universe made up of mathematical equations but Galileo (1564-1642) had

no qualms about turning his attention downward, to the forces which bring down moving objects and to mechanics, which had already become a craze in the fourteenth century when every European community took pride in having gigantic astronomical clocks. “No European community felt able to hold up its head unless in its midst the planets wheeled in cycles and epicycles, while angels trumpeted, cocks crew, and apostles, kings and prophets marched and countermarched at the booming of the hours.”<sup>21</sup> In fact, at the dawn of the seventeenth century, a clockwork universe was very much in the final stages of transforming the intellectual landscape of Europe.<sup>22</sup> However, it was left to Descartes (1596-1650) to articulate the signs of the times. “He emerged from his garden retreat fully convinced that the universe is precisely what it must in fact be, if it is to submit to mechanical description.”<sup>23</sup>

The mechanical world thus perceived was constituted of an independent entity—matter—that was subjected to mechanical laws and everything else had to be relegated to *res cogitans*, the thinking substance. This Cartesian duality was not without its own problems, as Descartes had himself recognized early in his life. He then spent the rest of his life attempting to extricate himself from the web of his own postulates. He fluctuated a great deal, sometimes being left with no recourse but to invoke a Deity to solve philosophical problems. Nevertheless, what he gave to the scientific world was a revolutionary idea which, in the hands of subsequent English materialists, went through further mutations until “by a curious reversal of Cartesian logic, the *res extensa* gained precedence over the *res cogitans*, or as one might almost say: the conjecture swallowed up the dream.”<sup>24</sup>

Thus, the most striking metaphor of the seventeenth century—the century of “mechanical philosophy”—was the clock and the main thrust of the mechanical philosophy was on explaining everything in terms of matter and motion. Descartes’ contribution to the rise of mechanical philosophy was his conception of the whole cosmos in terms of matter and motion. In his cosmos, humans differed from animals because they possess rational souls and had the capacity to think rationally and articulate intelligibly. In order to clearly differentiate humans from *animilas*, Descartes tried to formulate their existence on a separate plane. He thought that animals “have souls of an entirely different nature from ours... [The] fact is that they have no intelligence at all.”<sup>25</sup>

Yet, in spite of the emerging mechanical and materialist worldview, Kant (1724-1804) was to re-affirm at the end of the eighteenth century that “as the single being upon earth that possesses understanding, and,

consequently, a capacity for setting before himself ends of his deliberate choice, he [human being] is certainly the titular lord of nature, and, supposing we regard nature as a teleological system, he is born to be its ultimate end.”<sup>26</sup>

The eighteenth century was also a century in which most naturalists were obsessed with the idea of finding the “ultimate system” that would explain all variety. It was also a century of explorations. Carolus Linnaeus had undertaken an extensive expedition into northern Sweden to study the animal, vegetable, and mineral kingdoms at a young age. When he published his important work, *Systema Naturae* in 1735, he was only 28. This was followed by a stream of other publications, the last one being *Systema Vegetabilium*, published four years before his death in 1778.<sup>27</sup> He spent the better part of his life teaching natural history at the University of Uppsala in Sweden and inspired an entire generation of students who would travel to other parts of the world to collect data which would feed into the taxonomic systems conceived by their mentor.

Linnaeus’ is a Christian universe. The introduction to *Systema Naturae* is filled with awe and reverence for the God “who may be glorified in all his works” through contemplation of the created world.<sup>28</sup> He divided nature into three kingdoms (animals, plants, and minerals), and defined five branches, each subordinate to the one above it:

class, order, genus, species, and variety... Man, the last and the best of created works, formed after the image of his Maker, endowed with a portion of intellectual divinity, the governor and subjugator of all other beings, is, by his wisdom alone, able to form just conclusions from such things as present themselves to his senses, which can only consist of bodies merely natural. Hence the first step of wisdom is to know these bodies; and to be able, by those marks imprinted on them by nature, to distinguish them from each other, and to affix to every object its proper name.<sup>29</sup>

While anchored in the Christian worldview of his times, Linnaeus’ schema would be considered “racist” in later centuries; in any case, he certainly had the superiority of his own race in mind when he presented the concept of race and applied it to humans, proposing five taxa of a lower (unnamed) rank. These categories were Africanus, Americanus, Asiaticus, Europeanus, and Monstrosus. They were based first on place of origin, and later on skin color. Each race had certain characteristics that he considered endemic to individuals belonging to it.

Georges-Louis Leclerc, Comte de Buffon (1707-1788), the keeper of the Jardin du Roi in Paris and editor of the forty-four-volume work on natural history, *Histoire Naturelle*, which appeared between 1749-1804,<sup>32</sup> was bolder than Linnaeus in his claim that “the first thing that emerges from this thorough examination of nature is something that is perhaps rather humbling for man; it is that he must himself be ranked among the animals.” Buffon’s nominalist position, derived from John Locke (1632-1704),<sup>33</sup> made the system proposed by Linnaeus in his *Systema Naturae* utterly useless because he suggested an infinite number of forms shading into one another. He insisted that classes, orders, and genera existed only in imagination. Buffon, however, modified his ideas and by the time he published the fourth volume of the *Histoire Naturelle* in 1753, he was to propose a more precise definition of the concept of species based on functionality: it was the phenomenon of self-replication, rather than general similarities of forms, that defined a species.

This new definition, however, raised more problems than it resolved: there was no way to explain certain observable phenomenon such as the appearance of fertile hybrids. By 1766, Buffon was to add another element to his theory: environmental conditioning. This new element was to explain what might cause an initial group to split up into a set of related but distinct species. Thus, it was possible for zebras and asses to appear from a single stock (*souche*) of horses. Buffon referred to this process of splitting of a group into sub-groups as a process of “degeneration” and, though he had placed man in the first rank of the animal hierarchy of the Great Chain of Being, Buffon still considered the gap between apes and man an unbridgeable separation owing to the human ability of rational articulation.

Linnaeus and Buffon represent two opposite trends of the eighteenth century views on the nature of species. Linnaeus belonged to the Aristotelian tradition, Buffon to the neo-Platonic; Linnaeus constructed orderly systems, while Buffon aspired to place everything in the Great Chain of Being; Linnaeus thought in terms of categories and systems; Buffon was deeply interested in individual and specific processes. Yet both were concerned with the outward aspects of the organisms and both were interested in descriptions, definitions, classifications, and nomenclature. And though Buffon dealt with geographical distribution and variation under domestication, he was clearly not thinking in Darwinian terms. We have, thus, a movement toward evolution but not Darwinism, although



Darwin was to credit him for foreshadowing the concept of natural selection: “the first author who in modern times has treated it in a scientific spirit was Buffon.”<sup>34</sup>

### **Darwin’s Big Idea**

When Darwin’s “big book” appeared on November 24, 1859, it was received within a specific scientific, religious, intellectual, and social context created by his predecessors. To be sure, it was a fluid and ever-changing context, like all historical situations, yet there was something fundamentally and generally accepted in that particular context: anything called science was granted a high degree of respectability. Thus when Darwin’s “big idea” was presented as a scientific idea, supported by a very large amount of observational data, it immediately found a receptive audience. In actual fact, the book was not merely a scientific work dealing with facts and observations; it was the product of a certain view of nature, a particular belief system that informed the author’s outlook, and a certain way of interpreting what the author observed. Everything in the book (from the two quotations that appeared on the first page to the concluding statement) reflected a certain outlook informed by Darwin’s agnosticism.<sup>35</sup>

Already in his Linnean Society paper, presented on July 1, 1858, Darwin endorsed the claim of Augustin Pyramus de Candolle (1778-1841) that “all nature is at war”:

De Candolle, in an eloquent passage has declared that all nature is at war, one organism with another, or with external nature. Seeing the contented face of nature, this may at first be well doubted; but reflection will inevitably prove it to be true. The war, however, is not constant, but recurrent in a slight degree at short periods, and more severely at occasional more distant periods; and hence its effects are easily overlooked. It is the doctrine of Malthus applied in most cases with tenfold force.<sup>36</sup>

To claim that *all nature is at war* is not a statement of fact; it is an interpretation of a certain set of observations. This interpretation is based on some pre-conceived notions. In his book Darwin extended this notion and, more importantly, proposed a theory based on three claims, as Stephen Jay Gould postulated in 1977:

1. Organisms vary, and these variations are inherited (at least in part) by their offspring;
2. Organisms produce more offspring than can possibly survive;
3. On the average, offspring that vary most strongly in directions fa-

vored by the environment will survive and propagate. Favorable variation will therefore accumulate in populations by natural selection.<sup>37</sup>

Darwin's own full exposition of the theory appeared in the fourth chapter of his book—a chapter he considered “the key-stone of my arch”.<sup>38</sup> Appropriately titled “Natural Selection; or the Survival of the Fittest”, the chapter is perhaps the best example of how Darwin used the power of persuasive logic to his advantage. He presented his case through the following comparison between man and nature:

As man can produce and certainly has produced a great result by his methodical and unconscious means of selection, what may not nature effect? Man can act only on external and visible characters: nature cares nothing for appearances, except in so far as they may be useful to any being. She can act on every internal organ, on every shade of constitutional difference, on the whole machinery of life. Man selects only for his own good; Nature only for that of the being which she tends. Every selected character is fully exercised by her; and the being is placed under well-suited conditions of life. Man keeps the natives of many climates in the same country; he seldom exercises each selected character in some peculiar and fitting manner; he feeds a long and a short beaked pigeon on the same food; he does not exercise a long-backed or long-legged quadruped in any peculiar manner; he exposes sheep with long and short wool to the same climate. He does not allow the most vigorous males to struggle for the females. He does not rigidly destroy all inferior animals, but protects during each varying season, as far as lies in his power, all his productions. He often begins his selection by some half-monstrous form; or at least by some modification prominent enough to catch his eye, or to be plainly useful to him. Under nature, the slightest difference of structure or constitution may well turn the nicely-balanced scale in the struggle for life, and so be preserved. How fleeting are the wishes and efforts of man! how short his time! and consequently how poor will his products be, compared with those accumulated by nature during whole geological periods. Can we wonder, then, that nature's productions should be far “truer” in character than man's productions; that they should be infinitely better adapted to the most complex conditions of life, and should plainly bear the stamp of far higher workmanship?<sup>39</sup>

Thus, starting from an *a fortiori* argument organized around the maxim “whatever man can do, nature can do better”,<sup>40</sup> Darwin went on to carefully and systematically undermine previously held beliefs:

It is here, in his suggested social associations, that we see how Darwin's metaphor loosens the polysemous potential of language to potentially undermine a previous system of thought. What Gould presents accurately as a blind contest among biological forces directed only by the imperative to survive and leave offspring, Darwin presents as the handiwork of an agent who "scrutinizes" variations and adds them up using criteria that any stock breeder could recognize. By personifying Malthus's laws in the image of the breeder, Darwin contended with common sense for a cultural space in which his new idea could intelligibly appear. In this act of exaggeration and distortion in the interest of truth, he presented "natural selection" not merely as a collection of abstract laws of nature, but as a halfway house between mechanism and miracle. Asa Gray, Darwin's American supporter, a Harvard botanist and an orthodox Christian, in fact interpreted the figure in a providential sense. Thomas Henry Huxley took it in Darwin's intended sense as a figure. Wallace begged Darwin to drop the term, and popular as well as learned writers confused the term with a real force. That Darwin had his own reasons for retaining it is evident in his reply to Wallace in which he grants all of Wallace's objections but reaffirms the utility of his figure, irrespective of the incidental misunderstandings it generated.<sup>41</sup>

Darwin was not a scientist stuck in his laboratory; he was fully cognizant of the religious and intellectual challenges he was posing to the milieu in which he lived. He was, moreover, a master strategist who carefully planned his moves. His work was "strikingly and thoroughly thought through with respect to prior tradition (irrespective of whether we consider that tradition from the standpoint of religion, practical reason, or technical reason)".<sup>42</sup> For the first edition of his work, he chose two citations from the tradition of natural theology, and added a third in the second edition.<sup>43</sup> These flyleaf citations "clearly invite the reader to see the following work either as the last in the series of the old tradition of natural theology, or as the first in a line of thought marking a new tradition".<sup>44</sup>

More important than the flyleaf citations of the *Origin* is the opening paragraph of the work:

When on board H.M.S. "Beagle" as naturalist, I was much struck with certain facts in the distribution of the inhabitants of South America, and in the geological relations of the present to the past inhabitants of that continent. These facts seemed to me to throw some light on the origin of species—that mystery of mysteries, as it has been called by one of our greatest philosophers. On my return home, it occurred to me, in 1837,

that something might perhaps be made out on this question by patiently accumulating and reflecting on all sorts of facts which could possibly have any bearing on it. After five years' work I allowed myself to speculate on the subject, and drew up some short notes; these I enlarged in 1844 into a sketch of the conclusions, which then seemed to me probable: from that period to the present day I have steadily pursued the same object. I hope that I may be excused for entering on these personal details, as I give them to show that I have not been hasty in coming to a decision.

Clearly intended for “his fellow scientists, many of whom—particularly those in the Geological Society—were staunchly anti-theoretical, to see his theory as a product of the most conservative and strict strain of scientific method”, Darwin

does not claim to have come by his theory through an act as dangerous and willful as intentional theorizing from general laws of nature. In true Baconian fashion, he presents himself as a passive observer while an active nature hurled empirical evidence that “struck” him, thereby “throwing] light on the origin of species—that mystery of mysteries.” In response to nature’s active and implicitly theoretic bounty, Darwin himself passively (“it occurred to me . . . that something might perhaps be made out”) roused himself sufficiently after his return to “accumulate] and reflect . . . on all sorts of facts which could possibly have any bearing on it.”

Finally, after five years of living with these facts in a state of theoretic innocence, “I allowed myself to speculate on the subject,” and from this consummation, or forgivable lapse into intellection, and twenty years more of raising its fruits to respectability, has at last issued his theory. Equally important in Darwin’s first paragraph is his positioning of his theory as the ultimate outcome of the Beagle voyage—the subject of his first book, which itself had made his name as a scientific and popular writer. In presenting the *Origin* as a sequel to his *Journal of Researches*, Darwin appeals to a general as well as to a learned audience as he invites the lay public and his fellow scientists to join him on a second voyage of discovery.<sup>45</sup>

But it was his second major work, *The Descent of Man*, which completed the Darwinian “Revolution”, as it was later called, for what was missing in the *Origin of Species* was fully expressed by a triumphant Darwin in *The Descent of Man*.<sup>46</sup> The book would create one of the greatest controversies in the history of science and it continues to stir debates in all parts of the

world.

In the introduction of this work, he declared:

During many years I collected notes on the origin or descent of man, without any intention of publishing on the subject, but rather with the determination not to publish, as I thought that I should thus only add the prejudices against my views. It seemed to me sufficient to indicate, in the first edition of my '*Origin of Species*,' that by this work light would be thrown 'on the origin of man and his history;' and *this implies that man must be included with other organic beings in any general conclusion respecting his manner of appearance on this earth.*<sup>47</sup>

While writing *The Descent of Man*, Darwin was simultaneously responding to various debates and objections to his first book, as well as extending and exploring the logical implications of his big idea presented in the *Origin of Species*. More specifically, he was concerned with responding to influential opinion makers, such as George John Douglas Campbell (1823-1900), Duke of Argyll, who had strongly opposed Darwin's theory in his *The Reign of Law*,<sup>48</sup> on the grounds that beauty with no obvious utility, such as exotic birds' plumage, proved divine design. In order to counter the design argument, Darwin approached the subject through a specific theoretical lens (sexual selection). Darwin was also attempting to overcome a major stumbling point for many: could human mental faculties have evolved? To many critics of his theory, the gap between humans and even the smartest ape seemed too large. Wallace had already found refuge in spiritualism against the possibility of expansion of theory of evolution to include humans and he believed the human mind was too complex to have evolved gradually. Already in 1866, Wallace had written a pamphlet, *The Scientific Aspect of the Supernatural*,<sup>49</sup> which signaled his movement away from Darwinian evolution, and in 1869 he had published a review of a new edition of Lyell's *Principles of Geology*<sup>50</sup> in which Wallace explained the mechanism of evolution and defended the laws of natural selection that accounted for it. He also expressed the opinion that "there yet seems to be evidence of a Power which has guided the action of those laws in definite directions and for special ends." This was one of the first public expressions of a mystical turn that Wallace called his "little heresy". Darwin, warned in advance, had written anxiously to Wallace, "I hope you have not murdered too completely your own and my child."

In the Introduction to *The Descent of Man*, Darwin wrote:

The sole object of this work is to consider, firstly, whether man,

like every other species, is descended from some pre-existing form; secondly, the manner of his development; and thirdly, the value of the differences between the so-called races of man. As I shall confine myself to these points, it will not be necessary to describe in detail the differences between the several races—an enormous subject which has been fully discussed in many valuable works. The high antiquity of man has recently been demonstrated by the labours of a host of eminent men, beginning with M. Boucher de Perthes; and this is the indispensable basis for understanding his origin. I shall, therefore, take this conclusion for granted, and may refer my readers to the admirable treatises of Sir Charles Lyell, Sir John Lubbock, and others. Nor shall I have occasion to do more than to allude to the amount of difference between man and the anthropomorphous apes; for Prof. Huxley, in the opinion of most competent judges, has conclusively shewn that in every visible character man differs less from the higher apes, than these do from the lower members of the same order of Primates.<sup>51</sup>

Darwin argued on the basis of similarity of human beings to other animals. Beginning with anatomical similarities (body structure, embryology, and “rudimentary organs” which are presumably useful in one of man’s “pre-existing” forms), he moved on to argue for the similarity of mental characteristics. While demonstrating how human faculties (such as moral reasoning, sympathy for others, beauty, and music) can be seen in kind, if not degree, in other animal species (usually apes and dogs), he was aware of the implications of his logic: if humans were merely evolved form of other animals, there must be different degrees of evolution in different races and hence some races would be inferior to others, that is, at a lower level of evolution. Already in the United States, certain scientists were publishing monographs to prove that the “Negro” was inferior, incapable of existing with freedom, and hence slavery was beneficial for his survival. Some went even further and claimed that in fact, he cannot not survive without slavery, because that was his “natural” state.

Thus, when Herbert Spencer (1820–1903), the prominent English philosopher and sociological theorist of the Victorian era, coined the phrase “survival of the fittest” in his 1864 work *Principles of Biology*, which he wrote after reading Darwin’s *Origin*, he simply extended Darwin’s “big idea” to the realms of sociology and ethics. He argued that society would naturally sort itself out, and that the more “fit” individuals would rise to positions of higher prominence, while the less “fit” would succumb to poverty and disease. He alleged that government-run social programs and

charity would merely hinder the “natural” stratification of the populace.

Another extension of Darwin’s idea was proposed by Sir Francis Galton (1822-1911), Darwin’s half-cousin, who coined the term “eugenics” and the phrase “nature versus nurture”. Galton argued that just as physical traits were clearly inherited among generations of people, so too were mental qualities. That social mores needed to change so that heredity was a conscious decision in order to avoid over-breeding by “less fit” members of society and the under-breeding of the “more fit” ones. In Galton’s view, social institutions such as welfare and insane asylums were allowing “inferior” humans to survive and reproduce at levels faster than the more “superior” humans in respectable society, and if corrections were not soon taken, society would be awash with “inferiors.” Darwin read with great interest his cousin’s “admirable labours” and commented on his ideas in *The Descent of Man*:

A greater number of facts have been collected with respect to the transmission of the most trifling, as well as of the most important characters in man, than in any of the lower animals; though the facts are copious enough with respect to the latter. So in regard to mental qualities, their transmission is manifest in our dogs, horses, and other domestic animals. Besides special tastes and habits, general intelligence, courage, bad and good temper, &c., are certainly transmitted. With man we see similar facts in almost every family; and we now know, through the admirable labours of Mr. Galton,<sup>10</sup> that genius which implies a wonderfully complex combination of high faculties, tends to be inherited; and, on the other hand, it is too certain that insanity and deteriorated mental powers likewise run in families.<sup>52</sup>

Darwin then asserted that human character traits and mental characteristics are inherited the same way as physical characteristics. “Nevertheless the difference in mind between man and the higher animals, great as it is, certainly is one of degree and not of kind,” he claimed:

We have seen that the senses and intuitions, the various emotions and faculties, such as love, memory, attention, curiosity, imitation, reason, &c., of which man boasts, may be found in an incipient, or even sometimes in a well-developed condition, in the lower animals. They are also capable of some inherited improvement, as we see in the domestic dog compared with the wolf or jackal. If it could be proved that certain high mental powers, such as the formation of general concepts, self-consciousness &c., were absolutely peculiar to man, which seems extremely doubtful, it is not improbable that these qualities are

merely the incidental results of other highly-advanced intellectual faculties; and these again mainly the result of the continued use of a perfect language...

...That such evolution is at least possible, ought not to be denied, for we daily see these faculties developing in every infant; and we may trace a perfect gradation from the mind of an utter idiot, lower than that of an animal low in the scale, to the mind of a Newton.<sup>53</sup>

Darwin's fully expressed views on the origin of Man are spread in various chapters in *The Descent of Man*. Here is a typical example:

The early progenitors of man must have been once covered with hair, both sexes having beards; their ears were probably pointed, and capable of movement; and their bodies were provided with a tail, having the proper muscles. Their limbs and bodies were also acted on by many muscles which now only occasionally reappear, but are normally present in the Quadrummana.<sup>54</sup> At this or some earlier period, the great artery and nerve of the humerus ran through a supracondyloid foramen.<sup>55</sup> The intestine gave forth a much larger diverticulum or cæcum<sup>56</sup> than that now existing. The foot was then prehensile,<sup>57</sup> judging from the condition of the great toe in the foetus; and our progenitors, no doubt, were arboreal<sup>58</sup> in their habits, and frequented some warm, forest-clad land. The males had great canine teeth, which served them as formidable weapons. At a much earlier period the uterus was double; the excreta were voided through a cloaca;<sup>59</sup> and the eye was protected by a third eyelid or nictitating membrane. At a still earlier stage the progenitors of man must have been aquatic in their habits; for morphology plainly tells us that our lungs consist of a modified swim-bladder, which once served as a float. The clefts on the neck in the embryo of man show where the branchiæ<sup>60</sup> once existed. In the lunar or weekly recurrent periods of some of our functions we apparently still retain traces of our primordial birthplace, a shore washed by the tides. At about this same early period the true kidneys were replaced by the corpora wolffiana.<sup>61</sup> The heart existed as a simple pulsating vessel; and the chorda dorsalis<sup>62</sup> took the place of a vertebral column. These early ancestors of man, thus seen in the dim recesses of time, must have been as simply, or even still more simply organized than the lancelet or amphioxus.<sup>63</sup>





That Darwin was able to stir far-reaching debates in the scientific and religious circles of his time is logical, but the fact that he has been able to affect a much broader range of fields, such as sociology, psychology, anthropology, as well as the general beliefs of millions of people regarding the origin of life points to the presence of a receptive ground, ready to accept a radical shift in traditional beliefs. General circumstances of Western civilization at that time were such that it was ready to overthrow religion and Darwin's works helped accelerate that process. An anonymous reviewer of *The Descent of Man* pointed out these connections shortly after the publication of the book, which coincided with the establishment of the Paris Commune by socialists and republicans. The reviewer called Darwin's ideas "unscientific", and accused him of undermining fundamental principles of morality, and opening the way to "the most murderous revolutions":

We wish we could think that these speculations were as innocuous as they are unpractical and unscientific, but it is too probable that if unchecked they might exert mischievous influences. We abstain from noticing their bearings on religious thought although it is hard to see how, on Mr. Darwin's hypothesis, it is possible to ascribe to Man any other immortality or any other spiritual existence, than that possessed by Brutes. But, apart from these considerations, if such views as he advances on the nature of the Moral Sense were generally accepted, it seems evident that morality will lose all elements of stable authority, and "ever fixed marks" around which the tempests of human passion now break themselves would cease to exert their guiding and controlling influence... Men, unfortunately, have the power of acting not according to what is their ultimate social interest, but according to their ideas of it; and if the doctrine could be impressed on them that right and wrong have no other meaning than the pursuit or the neglect of that ultimate interest, Conscience would cease to be a check upon the wildest, or, as Mr. Darwin's own illustration allows us to add, the most murderous revolutions.

At a moment when every artificial principle of authority seem undermined, we have no other guarantee for the order and peace of life except in the eternal authority of these elementary principles of duty which are independent of all times and circumstances. There is much reason to fear that loose philosophy, stimulated by an irrational religion, has done not a little to weaken the force of these principles in France, and that this is, at all events, one potent element in the disorganization of

French society. A man incurs a grave responsibility who, with the authority of a well-earned reputation, advances at such a time the disintegrating speculations of this book. He ought to be capable of supporting them by the most conclusive evidence of facts. To put them forward on such incomplete evidence, such cursory investigation, such hypothetical arguments as we have exposed, is more than unscientific—it is reckless.<sup>64</sup>

Darwin called the connection “windbag full of metaphysics and classics”.<sup>65</sup>

As the nineteenth century progressed, Darwin gained many ardent supporters as well as equally strong critics of his ideas; in addition, there were those who changed their loyalties. For instance, George Jackson Mivart (1827-1900), the English biologist and initially an ardent believer in natural selection, later became one of its fiercest critics when he could not reconcile Darwinism with the beliefs of the Catholic Church. In January 1871 Mivart published a devastating critique of natural selection in an anonymous *Quarterly Review* article. T. H. Huxley, Darwin’s “bull-dog”, who had compared the *Origin* to Plato’s *Republic* and claimed “it will remain fresh for two thousand years”,<sup>66</sup> responded in September 1871 to the satisfaction of Darwin, who wrote back: “how you do smash Mivart’s theology... He may write his worst & he will never mortify me again”.<sup>67</sup>

Let us also recall what he wrote at the beginning of the third chapter of *The Descent of Man*:

We have seen in the last two chapters that man bears in his bodily structure clear traces of his descent from some lower form; but it may be urged that, as man differs so greatly in his mental power from all other animals, there must be some error in his conclusion. No doubt the difference in this respect is enormous, even if we compare the mind of one of the lowest savages, who has no words to express any number higher than four, and who uses hardly any abstract terms for common objects or for the affections, with that of the most highly organised ape. The difference would, no doubt, still remain immense, even if one of the higher apes had been improved or civilised as much as a dog has been in comparison with its present-form, the wolf or jackal. The Fuegians rank amongst the lowest barbarians; but I was continually struck with surprise how closely the three natives on board H.M.S. Beagle, who had lived some years in England, and could talk a little English, resembled us in disposition and in most of our mental faculties. If no organic being excepting man had possessed any mental power, or if his powers had been of a wholly different nature from those of the lower animals,

then we should never have been able to convince ourselves that our high faculties had been gradually developed. But it can be shown that there is no fundamental difference of this kind. We must also admit that there is a much wider interval in mental power between an ape and man; yet this interval is filled up by numberless gradations.<sup>68</sup>

### **Darwin's Religious Beliefs**

Much has been said about Darwin's religious beliefs. What appears to be almost certain is that Darwin started out a believer and ended up an agnostic. The attitude of his father toward religion and the trends and currents of his times were the most important contributing factors in the slow erosion of his traditional beliefs. Before losing his faith completely, he remained perplexed for a period of time during which he said and wrote certain things which complicate the question of Darwin's beliefs if one does not examine it in a chronological order. Here is a summary of Darwin's various expressions on faith during the final years of his life:

1. "My theology is a simple muddle: I cannot look at the Universe as the result of blind chance, yet I can see no evidence of beneficent Design." (Letter to Joseph Hooker, July 12, 1870)
2. "I can never make up my mind how far an inward conviction that there must be some Creator or First Cause is really trustworthy evidence." (Letter to Francis Abbot, September 6, 1871)
3. "I hardly see how religion & science can be kept as distinct as [Edward Pusey] desires... But I most wholly agree... that there is no reason why the disciples of either school should attack each other with bitterness." (Letter to J. Brodie Innes, November 27, 1878)
4. "I think that generally (& more and more so as I grow older) but not always, that an agnostic would be the most correct description of my state of mind." (Letter to John Fordyce, May 7, 1879)
5. "I am sorry to have to inform you that I do not believe in the Bible as a divine revelation, & therefore not in Jesus Christ as the son of God." (Letter to Frederick McDermott, November 24, 1880)

In the private part of his *Autobiography*, Darwin wrote:

Whilst on board the Beagle [October 1836-January 1839] I was quite orthodox, and I remember being heartily laughed at by several of the officers (though themselves orthodox) for quoting the Bible as an unanswerable authority on some point

of morality. I suppose it was the novelty of the argument that amused them. But I had gradually come, by this time, to see that the Old Testament; from its manifestly false history of the world, with the Tower of Babel, the rainbow as a sign, etc., etc., and from its attributing to God the feelings of a revengeful tyrant, was no more to be trusted than the sacred books of the Hindoos, or the beliefs of any barbarian.<sup>69</sup>

### **Tracing Back Darwin's Religious Beliefs**

One can trace back this erosion of belief and pinpoint one important event which might have consolidated Darwin's disbelief. It was the death of his nine-year-old daughter Annie on April 23, 1851 after ten painful months of illness. Already doubting, Darwin now saw suffering everywhere. In 1860 he was still struggling, as he wrote to Asa Gray:

With respect to the theological view of the question; this is always painful to me.— I am bewildered.— I had no intention to write atheistically. But I own that I cannot see, as plainly as others do, & as I sh<sup>d</sup> wish to do, evidence of design & beneficence on all sides of us. There seems to me too much misery in the world. I cannot persuade myself that a beneficent & omnipotent God would have designedly created the *Ichneumonidæ* with the express intention of their feeding within the living bodies of caterpillars, or that a cat should play with mice. Not believing this, I see no necessity in the belief that the eye was expressly designed. On the other hand I cannot anyhow be contented to view this wonderful universe & especially the nature of man, & to conclude that everything is the result of brute force. I am inclined to look at everything as resulting from designed laws, with the details, whether good or bad, left to the working out of what we may call chance. Not that this notion *at all* satisfies me. I feel most deeply that the whole subject is too profound for the human intellect. A dog might as well speculate on the mind of Newton.— Let each man hope & believe what he can.—

Certainly I agree with you that my views are not at all necessarily atheistical. The lightning kills a man, whether a good one or bad one, owing to the excessively complex action of natural laws,—a child (who may turn out an idiot) is born by action of even more complex laws,—and I can see no reason, why a man, or other animal, may not have been aboriginally produced by other laws; & that all these laws may have been expressly designed by an omniscient Creator, who foresaw every future event & consequence. But the more I think the more bewildered I become; as indeed I have probably shown by this letter.

Most deeply do I feel your generous kindness & interest.—

Yours sincerely & cordially | Charles Darwin.<sup>70</sup>

By the time he started to write *The Descent of Man*, Darwin thought religion and morality were evolved social characteristics. Dismissing religion as an innate quality, Darwin wrote: “There is no evidence that man was aboriginally endowed with the ennobling belief in the existence of an Omnipotent God. On the contrary there is ample evidence, derived not from hasty travellers, but from men who have long resided with savages, that numerous races have existed, and still exist, who have no idea of one or more gods, and who have no words in their languages to express such an idea.”<sup>71</sup>

Toward the end of *The Descent of Man*, Darwin said:

The belief in God has often been advanced as not only the greatest, but the most complete of all the distinctions between man and the lower animals. It is however impossible, as we have seen, to maintain that this belief is innate or instinctive in man. On the other hand a belief in all-pervading spiritual agencies seems to be universal; and apparently follows from a considerable advance in man’s reason, and from a still greater advance in his faculties of imagination, curiosity and wonder. I am aware that the assumed instinctive belief in God has been used by many persons as an argument for His existence. But this is a rash argument, as we should thus be compelled to believe in the existence of many cruel and malignant spirits, only a little more powerful than man; for the belief in them is far more general than in a beneficent Deity. The idea of a universal and beneficent Creator does not seem to arise in the mind of man, until he has been elevated by long-continued culture.

He who believes in the advancement of man from some low organised form, will naturally ask how does this bear on the belief in the immortality of the soul. The barbarous races of man, as Sir J. Lubbock has shewn, possess no clear belief of this kind; but arguments derived from the primeval beliefs of savages are, as we have just seen, of little or no avail. Few persons feel any anxiety from the impossibility of determining at what precise period in the development of the individual, from the first trace of a minute germinal vesicle, man becomes an immortal being; and there is no greater cause for anxiety because the period cannot possibly be determined in the gradually ascending organic scale.

I am aware that the conclusions arrived at in this work will be

denounced by some as highly irreligious; but he who denounces them is bound to shew why it is more irreligious to explain the origin of man as a distinct species by descent from some lower form, through the laws of variation and natural selection, than to explain the birth of the individual through the laws of ordinary reproduction. The birth both of the species and of the individual are equally parts of that grand sequence of events, which our minds refuse to accept as the result of blind chance. The understanding revolts at such a conclusion, whether or not we are able to believe that every slight variation of structure,—the union of each pair in marriage,—the dissemination of each seed,—and other such events, have all been ordained for some special purpose.<sup>72</sup>

Darwin's stature increased with years. Fame and honor was accompanied by inquiries about his religious beliefs. In an age when science was replacing religion for many, people wanted to know the beliefs of the man they considered the greatest living scientist of their times. Darwin mused about it: "Half the fools throughout Europe write to ask me the stupidest questions."<sup>73</sup> As already pointed out, at times he was short-tempered and quick in renouncing belief: "I am sorry to have to inform you that I do not believe in the Bible as a divine revelation, & therefore not in Jesus Christ as the Son of God".<sup>74</sup>

That Darwin remained perplexed about religion as well as the relationship between religion and science until his death is clear from his letters and responses toward the end of his life. Three years before his death, he received a letter from Nicolai Alexandrovitch Mengden (b. 1862), a Russian diplomat and student at Imperial University Dorpat (now Estonia), asking if a believer in his theory could also believe in God. Darwin asked his wife to respond in the affirmative. Mengden wrote again stating that Haeckel disbelieved in the supernatural—and what did Darwin think? This time Darwin responded:

Sir,—I am very busy, and am an old man in delicate health, and have not time to answer your, questions fully, even assuming that they are capable of being answered at all. Science and Christ have nothing to do with each other, except in as far as the habit of scientific investigation makes a man cautious about accepting any proofs. As far as I am concerned, I do not believe that any revelation has ever been made. With regard to a future life, every one must draw his own conclusions from vague and contradictory probabilities. Wishing you well, I remain, your

obedient servant,

CHARLES DARWIN.

Down, June 5, 1879.<sup>75</sup>

Yet, when Brodie Innes sent a sermon by E. B. Pusey to Darwin, he responded that he could “hardly see how religion & science can be kept as distinct as he desires, as geology has to treat of the history of the Earth & Biology that of man.”<sup>76</sup>

Darwin is known to have attended a séance at Erasmus’s house in January 1874, although it is said that when the room grew stuffy, Darwin went upstairs to lie down, missing the show involving sparks, sounds, and a table rising above their heads. On January 29, 1874, he later wrote to T. H. Huxley:

My dear Huxley

It was very good of you to write so long an account. Though the seance did tire you so much it was, I think, really worth the exertion, as the same sorts of things are done at all the seances even at Crookes; & now to my mind an enormous weight of evidence would be requisite to make one believe in anything beyond mere trickery.— It is a very significant fact that William now regularly goes to Crookes.— I am pleased to think that I declared to all my family the day before yesterday, that the more I thought of all that I had heard happened at Queen Anne St, the more convinced I was that it was all imposture.— I would not have believed that H. Wedgwood would so easily have been humbugged: my theory was that William managed to get the two men on each side of him to hold each others hands, instead of his, & that he was thus free to perform his antics.

Yours affecty | Ch. Darwin <sup>77</sup>

In 1876 Darwin wrote the following revealing words about his religious beliefs:

That there is much suffering in the world no one disputes. Some have attempted to explain this with reference to man by imagining that it serves for his moral improvement. But the number of men in the world is as nothing compared with that of all other sentient beings, and they often suffer greatly without any moral improvement. This very old argument from the existence of suffering against the existence of an intelligent First

Cause seems to me a strong one; whereas, as just remarked, the presence of much suffering agrees well with the view that all organic beings have been developed through variation and natural selection.

...This argument would be a valid one if all men of all races had the same inward conviction of the existence of one God; but we know that this is very far from being the case. *Therefore I cannot see that such inward convictions and feelings are of any weight as evidence of what really exists. The state of mind which grand scenes formerly excited in me, and which was intimately connected with a belief in God, did not essentially differ from that which is often called the sense of sublimity; and however difficult it may be to explain the genesis of this sense, it can hardly be advanced as an argument for the existence of God, any more than the powerful though vague and similar feelings excited by music.* Formerly I was led... to the firm conviction of the existence of God and the immortality of the soul. In my Journal I wrote that whilst standing in the midst of the grandeur of a Brazilian forest, 'it is not possible to give an adequate idea of the higher feelings of wonder, admiration, and devotion, which fill and elevate the mind.' *I well remember my conviction that there is more in man than the mere breath of his body. But now the grandest scenes would not cause any such convictions and feelings to rise in my mind.*<sup>78</sup>

In conclusion, it is worthwhile to quote the last paragraph of Paul Marston's "Darwin and Christian Faith", one of the clearest expositions of Darwin's religious beliefs:

Charles Robert Darwin was brought up as an Anglican with Unitarian leanings. At Edinburgh 1825-27 Darwin was well aware of the materialist controversies, but at Cambridge 1827-31 Darwin was fairly orthodox in Christian beliefs, though not naturally pious, and he assented to the 39 Articles of the Church of England when he graduated. On the Beagle he read the Bible and remained fairly orthodox, though was having more doubts. Any Christian belief waned after 1836 with a rising deterministic materialism, and after 1851 Darwin no longer even believed in a benevolent God. Darwin remained some kind of theist/deist until the 1860's, after which Darwin was self-confessedly muddled but belief in God further waned. Darwin thought to the end that evolution was compatible with some kind of Christian belief, but Darwin certainly had no eleventh hour conversion, nor personal spiritual renewal. Darwin died in 1882 as an agnostic, sorrowfully parting from his beloved and devout wife Emma, in a separation which both of them (for





Fig 1

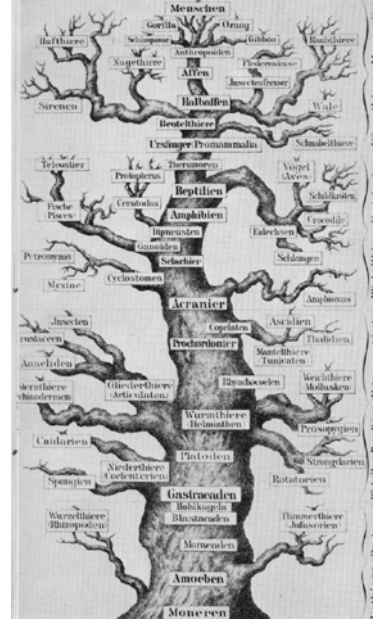


Fig 2

Fig 1: Haeckel's representation of the Descent of Man  
 Fig 2: Picture of Evolutionary Tree by Ernst Haeckel

different reasons) believed to be final.<sup>79</sup>



### Ever Since Darwin

Darwin's doctrine, fully expressed in *The Descent of Man*, was eagerly taken up by Ernst Haeckel (1834-1919) in Germany who had flair for graphic representations. He prepared a schematic "history of man's slow progress to the present" which shows how man evolved from the lower forms [Fig.1]. Note that number 23 in the evolutionary chain is obviously human and black. Ernst Haeckel also claimed that "ontogeny recapitulates phylogeny", that is to say, there exists a parallel between embryological development (ontogeny) and evolutionary history of the species (phylogeny) such that the embryo passed through certain "lower" evolutionary stages. Haeckel's embryology arose from a combination of Darwinism and Lamarckian notions of inheritance—the idea that traits acquired in an

organism's lifetime could be inherited and become the basis for progressive evolutionary change (Fig. 2).<sup>80</sup>

The Mutation Theory, proposed by Hugo de Vries (1848-1935) sought to revise Darwin's ideas. Hugo de Vries argued that slow, cumulative selection of minute variations was not the way new species evolved; rather, novelty in population was the result of discrete discontinuous changes, which he called "mutations". He tried to show how his theory could account for the appearance of a "genuinely new" species in one step. Basing his theory on his knowledge of agricultural breeding practices and controlled experiments designed to trace the appearance of mutations, de Vries argued that natural selection, acting on these small populations or "elementary species" merely determines which ones would survive.<sup>81</sup> Hugo de Vries was influential in generating enthusiasm among American biologists, who studied a large variety of plants and claimed discoveries of mutations at an astonishing rate. Interest in the theory of discontinuous variations and the possibility of controlling that discrete and abrupt change which produces new species was also influential in reviving interest in Mendelism.<sup>82</sup>

In 1906, William Bateson of the University of Cambridge used the term "genetic" at a scientific conference and revived interest in Mendel's work. But three years later, on the occasion of the centenary of Darwin's birth, a renewed interest in Darwin stifled Bateson's voice; he was severely attacked by the supporters of Darwin. The notions of continuity of species were re-emphasized and Batesonians and Mendelians were accused of exaggerating the prevalence of discontinuous variability in nature.

By then, Darwin had won solid support by scientists and evolution had become such a firm belief that it was regarded unscientific even to say a word against it. Against this background, any voice against Darwin and his ideas was ridiculed, even though certain scientists continued to oppose Darwinian ideas on scientific bases. In this regard, two important voices against Darwin's ideas need special mention: the first was that of Douglas Dewar (1875-1957), an ornithologist and a barrister who joined the British civil service, went to India, and wrote several books on the birds of India;<sup>83</sup> the second was that of Evan Shute, author of *Flaws in the Theory of Evolution*.<sup>84</sup> Dewar's most important work on evolution is his 1957 book, *The Transformist Illusion*,<sup>85</sup> although he wrote two other works on the subject.<sup>86</sup> That they were working against the current was obvious and is acknowledged by both Dewar and Shute. By the time they wrote, Darwin's ideas had been fully entrenched in the scientific milieu and no amount of criticism could dislodge them. "Evolution has become the intolerant

religion of nearly all educated western men,” Shute noted.<sup>87</sup>

Dewar’s arguments were both scientific and philosophical:

All the breeds derived from a common stock, no matter how much they differ from one another in appearance, are fertile when bred *inter se*, and all clearly bear the stamp of their ancestral form; all the breeds of pigeons are clearly pigeons, all those of horses plainly horses, all those of dogs undeniably dogs. The animals themselves appreciate this; a puppy of any breed at once recognizes an individual of any other breed of dog as one of his own kind...<sup>88</sup>

Dewar was to further argue that

One of the reasons why the evolution theory was so readily accepted is that the theory of creation was supposed to involve the occurrence of miracles while the theory of evolution dispenses with them. It is submitted that the latter supposition is not justified. If the assertion that the whale is a separate creation involves a miracle, the assertion that the whale gradually evolved from some land animal appears to involve two miracles—a gradual transformation that appears to be physically impossible, and the preservation of a long line of succeeding generations of the animal in question during the transformation.<sup>89</sup>

The 1937 publication of *Genetics and the Origin of Species* by the Russian naturalist Theodosius Dobzhansky,<sup>90</sup> who came to New York in 1927 and remained in the United States for the rest of his life, established the field of genetics on an experimental footing. Dobzhansky, a trained entomologist, cooperated with experimental geneticist Alfred H. Sturtevant in the 1930s and focused on wild populations of fruit flies for the study of evolution in nature. Dobzhansky argued that microevolution (genetic processes that produce small evolutionary changes) and macroevolution (broader patterns of evolution observable in the fossil record) were part of a single continuum and thus all evolutionary patterns could be explained by the ordering of small genetic changes by natural selection.

Dobzhansky’s work was further supported by others who focused on causal mechanisms—the how and why of evolution—rather than on simple description of the evolutionary record. Thus “C.D. Darlington’s *The Evolution of Genetic Systems* (1939), Ernst Mayr’s *Systematics and the Origin of Species* (1942), George Gaylord Simpson’s *Tempo and Mode in Evolution* (1944) and G. Ledyard Stebbins’ *Variation and Evolution in Plants* (1950) refocused attention on the detailed study of evolution as a process, with an emphasis on how natural selection operated and what its effects were.”<sup>91</sup>

In the 1940s, the “hopeful monster” theory of geneticist Richard Goldschmidt became famous. It basically proposed that occasionally large, coordinated changes might occur just by chance. In 1958, when J. C. Kendrew determined the structure of myoglobin using X-ray crystallography, it came to light that proteins were not a simple and regular structure like salt crystals; they were extremely complex. With the advancement of Nuclear Magnetic Resonance (NMR), it became even easier to determine the structure of complex proteins—but one thing these instruments could not do is produce evidence for even a single new species formed by the accumulation of mutations.

With the development of more sophisticated instruments, computers, and through the investment of millions of dollars of research funding, evolutionism became the mantra of post-World War II Western science. The postwar decades also saw the reemergence of interest in mathematical approaches. Population geneticists and population ecologists joined hands with biologists and mathematicians to produce an enormous body of literature which used different theological and philosophical ideas as well as insights derived from certain new areas such as game and information theories. Von Frisch, Konrad Lorenz, and Niko Tinbergen, the winners of 1973 Nobel Prize for their work in ethology,<sup>92</sup> focused on the experimental analysis of data concerning the organization and elicitation of individual and social behavior patterns of animals. Von Frisch published his famous work on the “dance language” of bees, revealing the complexity of “lower organisms” and Lorenz’s pioneering work on birds demonstrated how experiments could cast light on instinctive behavior. This renewed interest in ethology stimulated research in the field of ecology and in the study of genetics in relation to behavior, opening up new areas of research in evolutionary biology.

In 1975, a Harvard biologist, Edward O. Wilson, published *Sociobiology: The New Synthesis*.<sup>93</sup> The book claimed to open a new field of sociobiology at a time when Francis Crick and James Watson were riding the wave of popularity following their discovery of the double-helical structure of DNA. Wilson’s emphasis on the biological basis of behavior over cultural and historical causes and his extrapolation of results from zoology to humans were considered to be highly speculative. Social behavior was seen as adaptive traits molded by natural selection and genetic reductionism was considered a valid methodology. Richard Dawkins’ 1976 book *The Selfish Gene*<sup>94</sup> further strengthened the notion of genetic determinism. There were surely voices against these trends. Those who found the methodol-

ogy of sociobiology speculative and unsound were, however, not always successful and the evolutionary and genetic study of behaviour arched over to such fields as anthropology and psychology; it also revived interest in primatology.<sup>95</sup>

The early 1970s also saw the rise of a new theory, “punctuated equilibrium”. First proposed by American paleontologist Niles Eldredge and Stephen Jay Gould in 1972, this non-gradualistic model postulates that for long periods most species undergo little observable change and then a rapid change occurs in small, isolated populations. This explains why no fossil intermediates have been found.<sup>96</sup> Punctuationists emphasize speciation over phyletic evolution,<sup>97</sup> and opposed the uniformitarianism<sup>98</sup> that assumes the natural processes operating in the past were the same as those that can be observed operating in the present. Methodologically uniformitarianism considers the present to be the key to the past. The punctuation model, alternatively, emphasizes the abruptness with which the new forms appeared, including the sudden appearance of humans. It suggests an episodic sequence of events and not gradual directional change.

The twentieth century saw the emergence of many variations of Darwin’s original ideas, but all of these variations required the same blind force that had produced the original: chance and necessity. The differences were merely in the detail. These new theories included the novel idea of Cambrian explosion,<sup>99</sup> which was hailed as a biological Big Bang and which passed into history in short order. Although the seemingly rapid appearance of fossils in the “Primordial Strata”<sup>100</sup> was noted as early as the mid-19th century, and Darwin considered it as one of the main objections to his theory of evolution by natural selection, it gained new support in the twentieth century.

For each new theory, there exists another refuting it. A case in point is the famous exchange between Francis Hitching, author of *The Neck of the Giraffe*, and Richard Dawkins, author of *The Blind Watchmaker*. Hitching had described the remarkable defensive system of the bombardier beetle as proof against blind chance. Dawkins inaccurately quotes this passage from *The Neck of the Giraffe*, which states:

*Brachinus*, commonly known as the Bombardier Beetle, squirts a lethal mixture of hydroquinone and hydrogen peroxide into the face of its enemy. These two chemicals, when mixed together, literally explode. So in order to store them inside its body, the Bombardier Beetle has evolved a chemical inhibitor to make them harmless. At the moment the beetle squirts the

liquid out of its tail, an anti-inhibitor is added to make the mixture explosive once again. The chain of events that could have led to the evolution of such a complex, coordinated and subtle process is beyond biological explanation on a simple step-by-step basis. The slightest alternation in the chemical balance would result immediately in a race of exploded beetles.<sup>101</sup>

Dawkins, in turn, proceeds to show the basic flaw of this statement by mixing the two chemicals in question. After describing the case from Hitching, Dawkins writes with relish:

A biochemist colleague has kindly provided me with a bottle of hydrogen peroxide, and enough hydroquinone for 50 bombardier beetles. I am now about to mix the two together. According to the above, they will explode in my face. Here goes... well, I'm still here. I poured the hydrogen peroxide into the hydroquinone, and absolutely nothing happened. It didn't even get warm.<sup>102</sup>

Dawkins then goes on to explain that though the bombardier beetle does squirt a scalding hot mixture of hydrogen peroxide and hydroquinone at enemies, these two chemicals do not react until a catalyst is added. And he makes the point that these chemicals were present in the body for other reasons and the ancestors of the bombardier beetle evolved the mechanism of using these chemicals for defence—chemicals which “happened to be around”. And he finishes his case by stating: “That’s often how evolution works.”<sup>103</sup>



With the discovery of deoxyribonucleic acid (DNA),<sup>104</sup> the battleground shifted to even smaller scales. Evolutionary processes had to be placed in the DNA of a reproductive cell. Here too we have a plethora of theories, each claiming to solve the ultimate problem of biological origins. But each, with its antithesis. Thus from DNA, the hope of neo-Darwinists shifted to RNA (ribonucleic acid), a single-strand molecule which was thought to be an integral collaborator of DNA in protein synthesis.

An important scientific challenge to Darwinism was posed by three Protestant scientists, Charles B. Thaxton, Walter L. Bradley and Roger L. Olsen, in their 1984 book *The Mystery of Life's Origin*.<sup>105</sup> In his foreword to the book, Dean H. Kenyon, a Catholic professor of biology at San Francisco State University, pointed out that there existed a fundamental flaw in the current theories about the origins of life. And this flaw was

none other than the undirected flow of energy through a primordial atmosphere and ocean, something to which Whitall Perry had already referred in his insightful book, *The Widening Breach*.<sup>106</sup>

In 1992, the Foundation for Thought and Ethics, C.S. Lewis Society, and Dallas Christian Leadership organized a symposium, “Darwinism: Scientific Inference or Philosophical Preference?” in which leading Darwinists and Intelligent Design proponents exchanged views. Ten leading scientists and philosophers gathered at the Southern Methodist University to debate on the question of origins. The theme of the symposium was taken from Phillip E. Johnson’s 1991 book, *Darwin on Trial*.<sup>107</sup> The symposium was an attempt to show how Darwinism and neo-Darwinism, as generally held and taught in America, “carry with them an *a priori* commitment to metaphysical naturalism, without which it is impossible to make a convincing case in their behalf”.<sup>108</sup>

The publication of Michael Denton’s *Evolution: Theory in Crisis* further weakened the strong hold of evolutionism.<sup>109</sup> This was followed by a 166-page illustrated book, *Of Pandas and People: The Central Question of Biological Origins*<sup>110</sup> by Percival Davis and Dean H. Kenyon and the birth of a new force in the debate on origins: the Intelligent Design (ID) Movement. Using six case studies, the authors of this illustrated book examined Darwinian and ID explanations to see which better matched the scientific data. Two years later, Phillip E. Johnson, a lawyer by profession who taught law at the University of California, Berkeley published *Darwin on Trial*<sup>111</sup> in response to Richard Dawkins’s *The Blind Watchmaker*. The book reads like a lawyer’s arguments in a case. In this as well as in a subsequent book, *Reason in the Balance: The Case against Naturalism in Science, Law and Education*,<sup>112</sup> Johnson showed how the assumption that naturalism is the only legitimate way of doing science was unsound.

This was followed by a war of words and actions. The Governor of Alabama used his discretionary funds to send copies of *Darwin on Trial* to all biology teachers in the state but the main proponent of evolution, Stephen Gould, dismissed it as “scarcely more than an acrid little puff, unworthy of any serious response”. About the same time, Kenyon’s department at the San Francisco State University ordered him to stop teaching “creationism”. These events fueled the debate but they also brought the proponents of the Intelligent Design closer. The publication of Michael J. Behe’s *Darwin’s Black Box: The Biochemical Challenge to Evolution*<sup>113</sup> posed a major challenge to the evolutionists. Behe, a Catholic biochemist at Lehigh University, used the examples of vision, blood-clotting, cellular

transport, and other biochemical processes to demonstrate that the generally accepted belief in evolution may not be a sound scientific theory. For Darwinian evolution to be true, there must have been a series of mutations, each of which produced “working machines” that led to the complexity we now see. Behe argued that “biochemical machines” must have been designed either by God or by some higher intelligence. Writing in a milieu which discredits creationism as anti-science, Behe avoided certain terms and metaphors which would have provided reasons to the evolutionists to brand his book as another creationists’ tract. Instead, his arguments rest on minute and complex biochemical details: the complexity of the bacterial flagellum, the chemicals involved in the process of vision, scores of proteins which act in the process of blood clotting and many others. His book has been couched in popular, even jovial terms: he even uses the popular Calvin and Hobbes jokes! Nonetheless, *Darwin’s Black Box* posed a serious challenge to the evolutionists, a challenge they have not been able to meet.

The ID theorists have established a center, they publish the journal *Origins and Design*, and their Discovery Institute in Seattle and Center for the Renewal of Science and Culture has been the hub of a large and ongoing collaborative work. In addition to Michael Behe, three philosophers of science, Paul A. Nelson, Stephen C. Meyer, and William A. Dembski, have played a leading role in establishing the ID movement on firm basis. Dembski’s book *The Design Inference*<sup>114</sup> is a formidable exercise in generating mathematical proof for design by eliminating chance through small probabilities. He uncovers intelligent causes by isolating the specified events of small probability. When a highly improbable event is also specified (that is, conforms to an independently given pattern), undirected natural causes lose their explanatory power. To be sure, the book is a modern version of the classical design argument, but is one which is firmly based in mathematical sophistication and logical deductions.

### **The Theological Challenge**

Perhaps no other theory of modern science has challenged the religious worldview more seriously than evolutionism. True, Copernicus and Galileo had challenged the literal reading of Joshua, where the Lord tells the Sun: “Sun, stand thou still at Gibeon, and thou Moon in the valley of Aijalon. And the sun stood still, and the moon stayed, until the nation took vengeance on their enemies.”<sup>115</sup> And Lyell’s work had called into question the minuscule time scale of the Old Testament and there had



been much soul searching within Christianity over what later became known as Copernican Revolution and the uniformitarianism of Lyell. But Darwin's theory posed a direct challenge, especially its extrapolation to the origin of human beings.

But let us also note that ever since the Renaissance, the Bible had gradually been losing its force against the questioning attitude of science and critics had pointed out numerous inconsistencies and incompatibilities with the emerging scientific data. This was the subject of the two volume work by A.D. White, *A History of the Warfare of Science with Theology in Christendom*.<sup>116</sup> By the nineteenth century, the so-called movement of "higher criticism"<sup>117</sup> was well established in Protestant Germany and Holland. But England was still firmly entrenched in the traditional views. Six years after the reading of Darwin's paper on natural selection at the meeting of the Linnean Society, eleven thousand Anglican clergymen signed the "Oxford Declaration" of 1864, which declared that if any part of the Bible were admitted to be in error, all might be doubted. This Declaration was not directed against evolutionism per se, but against a group of seven liberal theologians who had published a volume, *Essays and Reviews*, in 1860 in response to the threats posed by Darwin.<sup>118</sup>

#### **The Position of the Vatican**

Darwin's *Origin of Species* had little to do with the question of human nature but his descent into the origin of humans was a frontal attack on the belief system held by the adherence of all religious traditions. For Catholics, the immortal soul, the original Divine creation of just one human couple, the final resurrection, and moral choice are central doctrines. Darwin's wholly naturalistic explanation of corporeal evolution of humans from lower organisms was clearly at variance with the ideas of a unique creation by God, in His own image, of a man who was, furthermore, imbued with the Lord's Spirit. In 1870, the Vatican Council pronounced the doctrine of the infallibility of the Pope and Augustinian and Thomistic roots of the Church had been strongly reaffirmed.

In 1893, Pope Leo XIII issued an encyclical, *Providentissimus Dei*, which re-asserted the position of the Church on the uncompromising literalism of the Bible:

All the books, which the Church receives as sacred and canonical, are written wholly and entirely, with all their parts, at the dictation of the Holy Ghost; and so far is it from being possible that any error can co-exist with inspiration, that inspiration not only is essentially incompatible with error, but excludes and re-

jects it as absolutely and necessarily as it is impossible that God Himself, the supreme Truth, can utter that which is not true.<sup>119</sup>

But by the turn of the century, Catholicism was well under the sway of scientific theories and by 1909, the Pontifical Biblical Commission was seeking a middle way between literalism and allegorical interpretations. However, it was clearly stated that the first three chapters of Genesis did contain a “narrative which corresponds to objective reality and historic truth.”<sup>120</sup>

In 1943, Pope Pius XII issued an encyclical, *Divine Afflante Spiritu*, which urged those who were trying to interpret the Old Testament to do so by trying to understand the ways and thinking and expression of the Near East in Biblical times.<sup>121</sup> In August 1950 Pope Pius XII issued his famous encyclical, *Humani Generis*, in which he said: “If anyone examines the state of affairs outside the Christian fold, he will easily discover the principal trends that not a few learned men are following. Some imprudently and indiscreetly hold that evolution, which has not been fully proved even in the domain of natural sciences, explains the origin of all this, and audaciously support the monistic and pantheistic opinion that the world is in continual evolution. Communists gladly subscribed to this opinion so that, when the souls of men have been deprived of every idea of a personal God, they may the more efficaciously defend and propagate their dialectical materialism.”<sup>122</sup> The Pope further said that “such fictitious tenets of evolution which repudiate all that is absolute, firm and immutable, have paved the way for the new erroneous philosophy which, rivaling idealism, immanentism and pragmatism, has assumed the name of existentialism, since it concerns itself only with existence of individual things and neglects all consideration of their immutable essences.”

Elaborating on the theme of historicism, Pius XII further stated: “There is also a certain historicism, which attributing value only to the events of man’s life, overthrows the foundation of all truth and absolute law both on the level of philosophical speculations and especially to Christian dogmas.” He reminded the “Catholic theologians and philosophers, whose grave duty it is to defend natural and supernatural truth and instill it in the hearts of men, [that they] cannot afford to ignore or neglect these more or less erroneous opinions. Rather they must come to understand these same theories well, both because diseases are not properly treated unless they are rightly diagnosed, and because sometimes even in these false theories a certain amount of truth is contained, and, finally because these theories provoke more subtle discussion and evaluation of

philosophical and theological truths.”

*Humani Generis* is a milestone in the evolution of Catholic thought on evolution for it cleared the way for an allegorical interpretation of the Genesis account of the creation of Earth and of humans. Though it stressed that in any discussion of evolution, the Catholics must take for granted the spiritual soul of man, it nevertheless relaxed the earlier position of the Church by accepting allegorical interpretations. Pope Pius warned that

If philosophers and theologians strive only to derive such profit from the careful examination of these doctrines, there would be no reason for any intervention by the Teaching Authority of the Church. However, although We know that Catholic teachers generally avoid these errors, it is apparent, however, that some today, as in apostolic times, desirous of novelty, and fearing to be considered ignorant of recent scientific findings try to withdraw themselves from the sacred Teaching Authority and are accordingly in danger of gradually departing from revealed truth and of drawing others along with them into error.<sup>123</sup>

On October 22, 1996 Pope John Paul II addressed the annual meeting of the Pontifical Academy of Science in Rome. His address was taken as a triumph for evolutionism, because he called “evolution a theory among theories”. Evolutionists considered this a victory, which they immediately celebrated. Just three days after the address was delivered at the Vatican, *Le Monde* saw in it a redemption of Darwin.<sup>124</sup> *Science* highlighted it with the telling title, “The Vatican’s Position Evolves”.<sup>125</sup> *Nature* outdid everyone by the caption: “Papal confession: Darwin was right about evolution.”<sup>126</sup> They announced as valid the claim that evolution is at least a theory worthy of consideration. Not everyone was happy with this shift. The report by Holden in *Science* expressed disappointment that the Papal address did not go further than the 1950 *Encyclical*,<sup>128</sup> although, in fact, it did.<sup>129</sup>

Whether or not the Papal statement supports evolution, it clearly grants an epistemological stature to modern science which is not in keeping with the established hierarchy of knowledge that has been in place for centuries in all spiritual traditions nor with the important philosophical studies on the scientific method which show how the so-called facts of science are always interpreted in the light of paradigms and that facts per se remain silent as long as an outside paradigm is not applied to them.<sup>130</sup>

“The generic epistemology found in [the Papal] statement is very weak,” the Italian microbiologist Giovanni Monastera pointed out in his seminal paper, “Darwinism: Scientific Theory or Historic Illusion?”<sup>131</sup>

Monastra states, “Many ambiguities can be found in the Pope’s speech. For example: is it possible for the Church to accept a revised version of Darwinism, where God is seen only as the Author of some ontological jumps during evolution? But is this version consistent with itself? In our opinion it is not. As we will see, Darwin’s theory, even if updated, is intrinsically materialistic, whereas a religious vision of life must be archetypal (and in the Pope’s words any reference to this aspect is lacking).”<sup>132</sup>

### **The Protestant Theologians**

A survey of Protestant responses to Darwinism is more difficult to make both because of the enormity of the material available on the subject as well as because of the number of positions held by different theologians. We can only attempt a brief outline.

An American contemporary of Darwin, botanist Asa Gray (1810-1888), had suggested that the main outline of the Darwinian theory might be accepted with the extra hypothesis that God was responsible for the occurrence of the favourable variations.<sup>133</sup> Other American theologians such as Henry Ward Beecher (1813-1887) and Frederick Temple tried to incorporate evolution in God’s design. Temple, who lectured on evolution at Oxford, suggested that God’s design might be recognized in the original act of creation and that the chemical elements were originally endowed with properties suitable for the formation of the world, as it is known to us by an evolutionary process.<sup>134</sup>

Let us also mention in passing that Temple, who was one of the authors of the controversial *Essays and Reviews* mentioned above, was appointed Archbishop of Canterbury in 1896 and this marked the silent acceptability of evolutionary theory by the Anglican Church.

### **American Response to Darwinism**

Darwin’s theory divided American religious communities just as it created foes and friends in other religious traditions all over the world. For those inclined toward accepting scientific data as a firm basis of faith, it was a question of accommodating Darwin’s theory into their faith and they quickly made room in their doctrines for the theory of evolution. But the majority of Americans “viewed Darwinism, especially when applied to humans, as erroneous, if not downright dangerous.”<sup>135</sup> The force of scientific discoveries kept pushing the boundaries of faith, however, and eventually even the most literalist believers of the Bible accepted the antiquity of life on earth. By the end of the nineteenth century, virtually the only Christians writing in defense of the recent appearance of life on

earth and attributing the fossil records to the action of Noah's flood were Seventh-Day Adventists.

During the 1920s, Presbyterian layman and three-time Democratic presidential candidate William Jennings Bryan launched a state-by-state campaign to outlaw the teaching of human evolution in public schools. By the end of the decade, they had succeeded in three states, Tennessee, Mississippi, and Arkansas, but their campaign added fuel to the debates on all aspects of evolution.

The famous Scopes trial of 1925 became a turning point in American responses to theory of evolution. Detailed treatment of these responses can be found in an excellent review on the subject in Ronald L. Numbers' *Darwinism Comes to America*.<sup>136</sup> More recent theological debates in America have focused on accommodating evolution within a broad biblical framework. "Most scholars start with the assumption that God is both the transcendent Creator *ex nihilo* of the universe *per se*," wrote Robert Russell in his seminal paper "Theology and Science: Current Issues and Future Directions,"<sup>137</sup> "including its existence and its fundamental laws, and the immanent, continuous Creator (*creatio continua*) who is acting everywhere in, with, and through natural processes to bring about physical and biological complexity. What science describes in terms of neo-Darwinian evolutionary biology is what theology sees as God's creative and providential action in the world. Evolution is thus the way God creates life, a broad position often called 'theistic evolution'."<sup>138</sup>

Among the most noteworthy contemporary responses to neo-Darwinism is Arthur Peacocke's response to Jacques Monod's assertion that chance events in nature point to the fundamental irrationality and meaninglessness of the world. Peacocke takes chance events—from genetic variation and expression to changes in populations and the environment—as divinely ordained, for God is the ground and source of both chance and law (or necessity). Thus, seen in this perspective, both chance and law serve as "God's means of continuously creating physical, chemical, and biological complexity and hence a world characterized by continuity and emergence, temporality and open-endedness...the appearance of self-conscious persons capable, according to the Judeo-Christian tradition, of relating personally to God can still be regarded as an intention of God continuously creating through the evolutionary development",<sup>139</sup> writes Peacocke. He "situates both the *ex nihilo* and the continuous creation tradition within a pantheistic doctrine of God, in which the world is within God even while God infinitely transcends the world. He articulates his theology of cre-

ation through a variety of models: God is a composer and improviser of unsurpassed ingenuity; like a mother, God births the world within herself though the world is other than God."<sup>140</sup>

Philip Clayton sees divine action in the emergence of new forms of life, though unlike Peacocke, he finds quantum physics to be a fruitful avenue for exploring God's immanent action in nature.<sup>141</sup> Ian Barbour also has a pantheistic view of God and the world, but his position falls within the Process perspective in which God is taken as a source of order and novelty, acting through indeterminacies in each of the integrated physical and biological systems, construed from a top-down cause. Evolution for Barbour is the product of law and chance within which God is continuously active. God influences events "through persuasive love, but He does not control them unilaterally."<sup>142</sup>

Barbour's pantheistic mind-body analogy for God's relation to the world is embedded within a social and ecological context that has an interpersonal perspective. God is, thus, the creative participant within the evolutionary community of beings and God nurtures the world through "tenderness, patience and responsiveness towards unchanging goals without coercing it through a ubiquitous, detailed plan."<sup>143</sup>

In the Summer 2000 issue of *Sophia*, Wolfgang Smith has proposed a solution to the apparent divergence in the scientific and certain Christian accounts of cosmos and life.<sup>144</sup> His article, entitled "The Extrapolated Universe", proposes a fundamental shift in our understanding of the cosmos to which the Bible refers. "We need first of all to ask ourselves whether the two divergent visions—the scientific and the Christian—refer indeed to the same cosmos, the same 'world'; and surprisingly, perhaps, one finds that in fact they do not."<sup>145</sup> Smith argues for an ontological distinction between the physical and the corporeal domains. He maintains that corporeal beings—things which can be perceived—are not the subject of physical sciences because physical sciences deal, ultimately, "with fundamental particles and their aggregates, things that are categorically imperceptible, and hence not corporeal."<sup>146</sup> Smith maintains that these particles and their aggregates constitute a second ontological domain, the Physical domain, and he does so while rejecting Cartesian premises and Whiteheadian bifurcation and adopting a realist view of sense perception. In other words, there is no trick of sense perception involved in his formulations:

It appears that in the course of the twentieth century, science has unveiled an imperceptible and hitherto unknown stratum

of cosmic reality. Never mind the fact that this remarkable discovery has been almost universally misconstrued on account of a Cartesian bias which in effect denies the corporeal: what concerns us in the present inquiry is that there are these two disparate domains—the physical and the corporeal—and that henceforth every cosmological debate shall need *de jure* to distinguish between these two “worlds”. Is it conceivable, then, that the corporeal world does in fact accord with the data of Genesis, that is to say, with the Patristic cosmology? I shall argue that this is indeed the case.<sup>147</sup>

He goes on to build a powerful case for the literal interpretation of the Bible for the corporeal realm, which is not the subject of physical sciences. He ends his article by hoping that “Christendom may soon awake from its protracted slumber, and casting off the yoke of a Darwinist cosmology, may rediscover the truth of its own worldview: a truth that is both factual and iconic, in accordance with the theophanic nature of the universe.”<sup>148</sup>

### Conclusion

Darwin’s big idea was resisted, opposed, and ridiculed by many of his contemporaries for both scientific and theological reasons, but in time it was accepted by the scientific community as a fact, even though a small segment of scientists continue to oppose it. The creation-evolution debate has been raging since 1859 and it has given birth to an unintelligibly vast range of concepts which are scattered between the two extremes of creation-evolution discourse.<sup>150</sup> Even the basic terms mean different things to different people. For example, the term evolution may refer to *teleological* evolution (a purposeful and designed process) or a *dysteleological* evolution (a process devoid of purpose and driven by chance only), that is, the basic molecules to humans theory. Likewise, the term creation can be understood to mean a whole range of concepts, from literal Biblical understanding to progressive creation to young earth creationism. This diversity of conflicting views is not only characteristic of different religious traditions; it is also present within single religious traditions, often cutting through the metaphysical fabric of tradition, leaving behind a debris of divisions in the communities of faith. This is obvious in each religious tradition.<sup>151</sup>

In addition to the confusion in terminology, we have a further component in this discourse that is related neither to the methodology nor to the scientific aspects of the discourse: the profound spiritual and moral consequences implicit in the very nature of the choices one has to make between intelligent design and its lack, between a teleological universe

and a dysteleological one. It is because of this intimate, personal, and profoundly human nature of this discourse that instead of rational, objective, and scientific discussion, bitter debates mark the boundary lines—debates which, to use Rabbi Goldberg’s phrase,<sup>152</sup> “shed heat, not light”.

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### Endnotes

1. “But I had gradually come, by this time, to see that the Old Testament; from its manifestly false history of the world, with the Tower of Babel, the rainbow as a sign, etc., etc., and from its attributing to God the feelings of a revengeful tyrant, was no more to be trusted than the sacred books of the Hindoos, or the beliefs of any barbarian.” *The Autobiography of Charles Darwin 1809-1882. With the original omissions restored. Edited and with appendix and notes by his grand-daughter Nora Barlow* (London: Collins, 1958), 85. The *Autobiography* and the entire collection of Darwin’s works is available at Darwin Online <<http://darwin-online.org.uk>>, accessed November 20, 2008. There are over 69,000 pages of searchable text and 175,000 electronic images in this online resource.

“I cannot pretend to throw the least light on such abstruse problems. The mystery of the beginning of all things is insoluble by us; and I for one must be content to remain an Agnostic.” *Autobiography*, 94.

Also, on a later date, Darwin wrote: “I am sorry to have to inform you that I do not believe in the Bible as a divine revelation, & therefore not in Jesus Christ as the son of God” (Letter to Frederick McDermott, November 24, 1880). *The Correspondence of Charles Darwin* (Cambridge: Cambridge University Press), 1991, now online at Darwin Correspondence Online (<<http://www.darwin-project.ac.uk>>); all references to the letters cited in the text and in these notes are from the online version of *The Correspondence of Charles Darwin*.

2. C. R. Darwin and A. R. Wallace, “On the tendency of species to form varieties; and on the perpetuation of varieties and species by natural means of selection.” [Read 1 July, 1858], published in the *Journal of the Proceedings of the Linnean Society of London, Zoology* 3 (20 August, 1858): 46-50; hereinafter “On the tendency of Species”.
3. The complete text of this famous paper is available at <[http://darwin-online.org.uk/pdf/1858\\_species\\_F350.pdf](http://darwin-online.org.uk/pdf/1858_species_F350.pdf)>, accessed November 20, 2008. It originally appeared in the *Journal of the Linnean Society of London, Zoology*. The events and correspondence between June 18, 1858, when Darwin received Wallace’s letter, and August 30, 1858, when the paper appeared in print, are given in *Life and letters*, Vol. II, 115-131. Darwin was not present at the meeting because of serious illness amongst his children. It has never been reprinted as a pamphlet, but occurs on several occasions in books and papers, first in 1908 in the Linnean Society’s celebrations of Darwin’s birth, and in 1930 in facsimile



in Sarton's paper in *Isis*. It was translated into German in Darwin's lifetime and into Italian and Russian since his death.

4. Lyell and Hooker's introduction to the papers as well as the complete text of the papers is available at <[http://darwin-online.org.uk/pdf/1858\\_species\\_F350.pdf](http://darwin-online.org.uk/pdf/1858_species_F350.pdf)>, accessed November 20, 2008.
5. *Ibid.*, 45.
6. Arnold C. Brackman has argued that Darwin received Wallace's paper earlier than he acknowledged, incorporated aspects of it into his own work, and then sent it on to Lyell pretending that it had just arrived, but his arguments remain unconvincing and the bulk of scholarly research suggests that it was a matter of two independent minds reaching at the same conclusion. For Brackman's arguments and research, see his *A delicate arrangement: the strange case of Charles Darwin and Alfred Russel Wallace* (New York: Times Books, 1980).
7. Francis Darwin (ed.), *The life and letters of Charles Darwin, including an autobiographical chapter* (London: John Murray, 1887), Vol. 3, 258; hereafter *Life and Letters*.
8. Jonathan Rosen, "Missing Link: Alfred Russel Wallace, Charles Darwin's neglected double", *The New Yorker*, February 12, 2007.
9. Wallace's letter was accompanied by the manuscript of his paper entitled "On the tendency of varieties to depart indefinitely from the original type". The date on which Darwin received Wallace's letter and manuscript has been the subject of debate. According to some scholars, the letter was probably posted between 5 and 19 March 1858 and should therefore have arrived at Down in May [John Langdon Brooks, *Just before the origin: Alfred Russell Wallace's theory of evolution* (New York: Columbia University Press, 1984), 262-3] or early June [Lewis H. McKinney, *Wallace and natural selection* (New Haven [Conn.]: Yale University Press, 1972), 138-40]. See also the Introduction to Volume 7 of *The Correspondence of Charles Darwin*.
10. On June 18, 1858, Darwin wrote to Lyell:

Your words have come true with a vengeance that I sh<sup>d</sup>. be forestalled. You said this when I explained to you here very briefly my views of "Natural Selection" depending on the Struggle for existence.—I never saw a more striking coincidence. if Wallace had my M.S. sketch written out in 1842 he could not have made a better short abstract! Even his terms now stand as Heads of my Chapters. Letter 2285—Charles Darwin to Charles Lyell, June 18, 1858.

Seven days later, he wrote again:

My dear Lyell

I am very very sorry to trouble you, busy as you are, in so merely personal an affair. But if you will give me your deliberate opinion, you will do me as great a service, as ever man did, for I have entire confidence in your judgment & honour.—

I sh<sup>d</sup>. not have sent off your letter without further reflexion, for I am at present

quite upset, but write now to get subject for time out of mind. But I confess it never did occur to me, as it ought, that Wallace could have made any use of your letter.

There is nothing in Wallace's sketch which is not written out much fuller in my sketch copied in 1844, & read by Hooker some dozen years ago. About a year ago I sent a short sketch of which I have copy of my views (owing to correspondence on several points) to Asa Gray, so that I could most truly say & prove that I take nothing from Wallace. I sh<sup>d</sup>. be *extremely* glad **now** to publish a sketch of my general views in about a dozen pages or so. But I cannot persuade myself that I can do so honourably. Wallace says nothing about publication, & I enclose his letter.—But as I had not intended to publish any sketch, can I do so honourably because Wallace has sent me an outline of his doctrine?—I would far rather burn my whole book than that he or any man sh<sup>d</sup>. think that I had behaved in a paltry spirit. Do you not think his having sent me this sketch ties my hands? I do not in least believe that that he originated his views from anything which I wrote to him.

If I could honourably publish I would state that I was induced now to publish a sketch (& I sh<sup>d</sup>. be very glad to be permitted to say to follow your advice long ago given) from Wallace having sent me an outline of my general conclusions.—We differ only, that I was led to my views from what artificial selection has done for domestic animals. I could send Wallace a copy of my letter to Asa Gray to show him that I had not stolen his doctrine. But I cannot tell whether to publish now would not be base & paltry: this was my first impression, & I sh<sup>d</sup>. have certainly acted on it, had it not been for your letter.

This is a trumpery affair to trouble you with; but you cannot tell how much obliged I sh<sup>d</sup>. be for your advice.—

By the way would you object to send this & your answer to Hooker to be forwarded to me, for then I shall have the opinion of my two best & kindest friends.— This letter is miserably written & I write it now, that I may for time banish whole subject. And I am worn out with musing.

I fear we have case of scarlet-fever in House with Baby.—Etty is weak but is recovering.—

My good dear friend forgive me.— This is a trumpery letter influenced by trumpery feelings.

Yours most truly | C. Darwin

I will never trouble you or Hooker on this subject again.—

Letter 2294—Charles Darwin to Charles Lyell, June 25, 1858.

Although Darwin ended the letter by saying “I will never trouble you or Hooker on this subject again,” yet on the very next day, he wrote again, for he was troubled by the feeling that he might be considered one who took advantage of knowing that Wallace is in the field and thereby lose his priority.

My dear Lyell

Forgive me for adding P.S. to make the case as strong as possible against myself.

Wallace might say “you did not intend publishing an abstract of your views till you received my communication, is it fair to take advantage of my having freely, though unasked, communicated to you my ideas, & thus prevent me forestalling you?” The advantage which I should take being that I am induced to publish from privately knowing that Wallace is in the field. It seems hard on me that I should be thus compelled to lose my priority of many years standing, but I cannot feel at all sure that this alters the justice of the case. First impressions are generally right & I at first thought it wd. be dishonourable in me now to publish.—

Yours most truly | C. Darwin

PS I have always thought you would have made a first-rate Lord Chancellor; & I now appeal to you as a Lord Chancellor.

Emma desires her affectionate thanks, in which I heartily join, to Lady L. for her most kind note.— Ety is very weak but progressing well. The Baby has much fever but we hope not S. Fever.— What has frightened us so much is, that children have died in village from Scarlet Fever, & others have been at death’s door, with terrible suffering. Letter 2295—Charles Darwin to Charles Lyell, June 26, 1858.

11. Jonathan Rosen, “Missing Link”, op. cit.
12. The General Meeting of the Society, scheduled for June, had been cancelled in honor of Robert Brown, but since a new Vice-President needed to be elected before the autumn session, an additional General meeting was organized for July 1, 1858. It was this meeting which included the reading of the papers which were originally due to be read in November, except for one from J.D. Hooker, which was withdrawn to make way for those by Darwin and Wallace. For these details, see Linnean Society’s official website at <<http://linnean.org/index.php?id=378>>, accessed November 28, 2008.
13. J. W. T. Moody, “The reading of the Darwin and Wallace papers”, *J. Soc. Bibliophy nat. Hist.* 5 (1971) 6, 474-476. In any case, Darwin was to feel satisfied by the outcome and he later wrote: “I gained much by my delay in publishing from about 1839, when the theory was clearly conceived, to 1859; and I lost nothing by it, for I cared very little whether men attributed most originality to me or Wallace; and his essay no doubt aided in the reception of the theory. I was forestalled in only one important point, which my vanity has always made me regret, namely, the explanation by means of the Glacial period of the presence of the same species of plants and of some few animals on distant mountain summits and in the arctic regions. This view pleased me so much that I wrote it out in extenso, and I believe that it was read by Hooker some years before E. Forbes published his celebrated memoir (*Geolog. Survey Mem.*, 1846.) on the subject. In the very few points in which we differed, I still think that I was in the right. I have never, of course, alluded in print to my having independently

worked out this view.” *Life and Letters*, Vol. 1, 88.

14. Nora Barlow, *The Autobiography of Charles Darwin 1809-1882* (London: Collins, 1958), 122.
15. *Ibid.*
16. Darwin had started the book on Tuesday, July 20, 1858, whilst on holiday at Sandown in the Isle of Wight. The details of its composition and publishing are given in Francis Darwin (ed.), *The life and letters of Charles Darwin, including an autobiographical chapter* (London: John Murray), 1887, Vol. II, 126-178. Darwin expected the book to be an abstract of some thirty pages to be published in the *Journal of the Linnean Society*, but by the winter it was clear that it would have to be a book, although Darwin was still called it an abstract at the end of March when he wrote out its title page which Lyell showed to Murray (*Life and Letters*, vol. 2, 152). This title page, now at the American Philosophical Society, Philadelphia, reads “AN ABSTRACT OF AN ESSAY/ON THE/ORIGIN/OF/SPECIES AND VARIETIES/THROUGH NATURAL SELECTION/BY/CHARLES DARWIN, M.A./FELLOW OF THE ROYAL, GEOLOGICAL, AND LINNEAN SOCIETIES/LONDON:/&c. &c. &c. &c./1859.” The book was published in November 1859. Darwin received a copy early in November; the book went on sale at Murray’s autumn sale on November 22, 1859. The print run was 1,250 copies, of which 1,192 were available for sale, the rest being twelve for the author, forty-one for review and five for Stationers’ Hall copyright. The title was shortened to *The Origin of Species* for the 6th edition of 1872.
17. Recent attempts to resurrect Wallace’s reputation have produced several new biographies; these include: John Grenfell Wilson, *The Forgotten Naturalist: In Search of Alfred Russel Wallace* (Victoria, Australia: Australian Scholarly Publishing, 2000); Ross A. Slotten, *The Heretic in Darwin’s Court: The Life of Alfred Russel Wallace* (New York: Columbia University Press, 2006); Peter Raby, *Alfred Russel Wallace: A Life* (Princeton: Princeton University Press, 2002); William Bryant, *The Birds of Paradise: Alfred Russel Wallace: a Life* (Bloomington: iUniverse, Inc., 2006); and Michael Shermer, *In Darwin’s Shadow: The Life and Science of Alfred Russel Wallace: A Biographical Study on the Psychology of History* (New York: Oxford University Press, 2002).
18. The year 2009 marks the 150th anniversary of the publication of *On the Origin of Species* and the 200th anniversary of Darwin’s birth; <<http://darwin-online.org.uk/2009.html>>, accessed December 22, 2008, provides information about worldwide events and publications to mark the occasion.
19. Letter 2514—Charles Darwin to John Murray, November 3, 1859.
20. Letter 2516—Charles Darwin to J. D. Dana, November 11, 1859. As it turned out, ill health prevented Dana from reading *Origin* until 1862.
21. Lynn White, *Medieval Technology and Social Change* (Oxford: Oxford University press, 1962), 124.
22. Wolfgang Smith, *Cosmos & Transcendence* (Peru: Sherwood Sugden & Company, 1984), 27. Smith also notes in passing that with the advent of this mechani-

cal view of the universe, there was a phenomenal change in the speed with which science was put to service. As soon as Galileo's mechanical discoveries were made public, they were put to use, for example in the pendulum clock, invented by Huygens in 1656.

23. *Cosmos & Transcendence*, 29.
24. *Ibid.*, 30.
25. René Descartes, *Discourse on Method and other Writings*, tr. with an introduction by Arthur Wollaston (Harmondsworth: Penguin, 1960), 81.
26. Immanuel Kant, *Critique of Judgement*, trans. with analytical indexes by James Creed Meredith (Oxford: Clarendon Press, 1952), 94.
27. Carlos Linnaeus, *Systema Naturae* [English. Selections], with an introduction and a first English translation of the "Observationes" by M.S.J. Engel-Ledeboer and H. Engel (Goy-Houten, Netherlands: HES & De Graaf Publishers, 2003), 12.
28. Sir Charles Linné, *A General System of Nature Through the Three Grand Kingdoms of Animals, Vegetables, and Minerals, systematically divided into their several classes, orders, genera, species, and varieties, with their habitations, manners, economy, structure, and peculiarities, translated from Gmelin, Fabricius, Wildenow, & c. together with various modern arrangements and corrections, derived from the classical works of Shaw, Thornton, Abbot, Donovan, Sowerby, Latiham, Dillwyn, Lewin, Martyn, Andrews, Lamberta, &c.&c. with a life of Linné, appropriate copper-plates, and a Dictionary of the terms which occur in the several Departments of Natural History, by William Turton, M. D. Fellow of the Linnean Society, Author fo the Medical Glossary, &c.&c. in seven volumes* (London: Lackington, Allen, and Co. 1806), 1-2.
29. *Ibid.*, 3.
30. *Amoenitates academicae*, 1763.
31. The original Latin text is available at <<http://linnaeus.c18.net/>>, letter number 0783>, accessed December 12, 2008.
32. G.L.L. de Buffon, *Histoire Naturelle, Générale et Particulière, avec la Description du Cabinet du Roi*, 44 vols. plus Atlas, Paris:1949-1804. Only 35 volumes appeared in Buffon's lifetime; the remaining were the work of Comte de Lacépède (1756-1825). The full online version is now available at <http://www.buffon.cnrs.fr/>; digital text at the University of Kyoto at <[http://edb.kulib.kyoto-u.ac.jp/exhibit/b16/buffon\\_cont.html](http://edb.kulib.kyoto-u.ac.jp/exhibit/b16/buffon_cont.html)>; accessed December 2, 2008; digital text of the *Natural history of birds* (all 9 volumes), <<http://www.oiseaux.net/buffon/buffon.html>>, accessed December 4, 2008.
33. John Locke claimed that even the best definition merely gave the *nominal* essence of a thing, never the *real* essence. The name of thing simply indicated the class of that thing for which, by general usage, the name was considered to be appropriate. Since conventions about word usage were susceptible to change, the categories by which objects were grouped and named were in no

way God-given or fixed according to an essential criteria. Thus nominalism considered it perfectly possible to group objects in unconventional ways and allot new names or redistribute the old names.

34. Foreword to the 6th edition of the *On the Origin of Species*.
35. Even the title of the book, written in capital letters, *ON|THE ORIGIN OF SPECIES|BY MEANS OF NATURAL SELECTION,|OR THE| PRESERVATION OF FAVOURED RACES IN THE STRUGGLE|FOR LIFE*, and the significance given to the author's scientific associations (CHARLES DARWIN, M.A., FELLOW OF THE ROYAL, GEOLOGICAL, LINNEAN, ETC., SOCIETIES); and his credentials (AUTHOR OF 'JOURNAL OF RESEARCHES DURING H.M.S. BEAGLE'S VOYAGE ROUND THE WORLD') are important reminders of the power and prestige attached to the science and scientific societies. The full text of the first edition is now available at <<http://darwin-online.org.uk/contents.html#books>>, accessed December 15, 2008, along with the 1860, 1861, 1866, 1869, and 1872 editions. All references are to the online edition.
36. "On the tendency of Species".
37. Steven Jay Gould, *Ever Since Darwin* (New York: Norton, 1977), 11.
38. "If you choose to read Ch. II & III, you will have a dull & rather abstruse Ch. & a plain & interesting one in my opinion...I presume you will wish to see Ch. IV, the key-stone of my arch, & Ch. X & XI..." Letter 2447—Darwin to John Murray, 5 Apr [1859]. *Darwin Correspondence Online*.
39. *The Origin of Species*, 83-4.
40. John Angus Campbell, "Why Was Darwin Believed? Darwin's Origin and the Problem of Intellectual Revolution" in *Configurations*, Spring 2003. Vol. 11, Iss. 2, 203-238.
41. *Ibid.*
42. *Ibid.*
43. The first was from W. Whewell's *Bridgewater Treatise*: "But with regard to the material world, we can at least go so far as this—we can perceive that events are brought about not by insulated interpositions of Divine power, exerted in each particular case, but by the establishment of general laws." The second was from Bacon's *Advancement of Learning*: "To conclude, therefore, let no man out of a weak conceit of sobriety, or an ill-applied moderation, think or maintain, that a man can search too far or be too well studied in the book of God's word, or in the book of God's works; divinity or philosophy; but rather let men endeavour an endless progress or proficience in both." The third came from Butler's *Analogy of Revealed Religion*: "The only distinct meaning of the word "natural" is stated, fixed, or settled; since what is natural as much requires and presuppose an intelligent agent to render it so, i.e., to effect it continually or at stated times, as what is supernatural or miraculous does to effect it for once."
44. *Ibid.*

45. Ibid.
46. Darwin's second major work, first published in 1871, in which Darwin presents the "evidence" of the descent of Man from some lower form (ch. I) along with a complete "mechanism" of the "manner of development of man from some lower form" (ch. III), went through three reprints between February and December of 1871. Its second edition was printed in one volume in November 1874; a third edition appeared in 1882. It was translated into Danish, Dutch, French, German, Italian, Polish, Russian, and Swedish in Darwin's lifetime and into many other languages since. All editions of *The Descent of Man* are now available online <<http://darwin-online.org.uk/contents.html#books>>, along with a full bibliography. All references are to the online editions, hereinafter *The Descent of Man*.
47. *The Descent of Man*, Introduction, emphasis added.
48. George Campbell, *The Reign of Law* (London: Strahan, 1867).
49. Not be confused with Wallace's 1875 book *On Miracles and Modern Spiritualism*, which is a heavily revised version of the original pamphlet now available online at <<http://www.wku.edu/~smithch/wallace/S118A.htm>>, accessed November 20, 2008. It has been edited by Charles H. Smith from the original 1866 pamphlet edition (a very rare item, of which only three copies are held by libraries anywhere in the world).
50. Charles Lyell, *Principles of Geology* (London: J. Murray, 1830-33).
51. *The Descent of Man*, 2.
52. *The Descent of Man*, 27-8.
53. *The Descent of Man*, 127.
54. The mammalian group that includes monkeys, apes, baboons and lemur.
55. A hole through the humerus just above the elbow joint, found in reptiles and human embryos.
56. A *cul-de-sac* of the alimentary canal, branching off at the junction of the small and large intestines.
57. Meaning capable of grasping or taking hold of something.
58. That is, pertaining to trees; treelike.
59. That is, the common passage by which alimentary and urinary excretion occurs in birds, reptiles, fish and monotremes (egg-laying mammals).
60. Gills.
61. A primitive kidney, as it appears in the intermediate embryonic states of development.
62. A cartilaginous rod found in vertebrate embryos, running between the primitive vertebrates such as the lancelet or *Amphioxus*.
63. *The Descent of Man*, 160-1.

64. "Mr. Darwin on the Descent of Man", *The Times*, April 7 and 8, 1871. Anonymous review of Darwin's book available online at <<http://archive.timesonline.co.uk>>, accessed December 19, 2008.
65. Letter 7680—Charles Darwin to Murray, John (b), April 13, 1871.
66. Letter 7973—T. H. Huxley to C. R. Darwin, September 28, 1871.
67. Letter 7976—Darwin to T. H. Huxley, September 30, 1871.
68. *The Descent of Man*, 99
69. *Autobiography*, 85.
70. Letter 2814 —Charles Darwin to Asa Gray, May 22, 1860.
71. *The Descent of Man*, 93.
72. *The Descent of Man*, 612-13.
73. Letter 11982—Charles Darwin Reginald Darwin, April 8, 1879.
74. Letter 12851—Charles Darwin to F. A. McDermott, November 24, 1880.
75. Darwin's letter was published in a German translation in *Haeckel* 1882, 89. Mengden's first letter was written on April 2, 1879. <<http://darwin-online.org.uk/content/frameset?viewtype=text&itemID=F1973&pageseq=1>>, accessed December 18, 2008.
76. That is, science deals with subjects essential to religions. Letter 11763—Charles Darwin to J. B. Innes, November 27, 1878.
77. Letter 9258—Charles Darwin to T. H. Huxley, January 29, 1874.
78. *Life and Letters*, vol. 1, 311-12, emphasis added.
79. This article appears on Paul Marston's website, <<http://www.paulmarston.net/papers/scienceandreligion.html>>, accessed December 20, 2008. Also see G. Ledyard Stebbins and F. J. Ayala, "The Evolution of Darwinism," in *Scientific American*, 253 (July 1985) 54; Ernan McMullin, *Evolution and Creation* (Notre Dame: University of Notre Dame Press, 1985), 59-90; and G. Ledyard Stebbins, *Darwin to DNA, Molecules to Humanity* (San Francisco: W.H. Freeman, 1982).
80. Figure 1 is from Pearce L. Williams, *Album of Science: The Nineteenth Century* (New York: Charles Scribner's Sons, 1978), 292, and figure 2 is from Ernst Haeckel, *The Evolution of Man: A Popular Scientific Study* (London: Watts, 1910), 5th ed. vol. 2.
81. Hugo de Vries, *The Mutation Theory*, translated by J.B. Farmer and A.D. Darbishire (Chicago: Open Court Publishing Company, 1909).
82. Ernst Mayr, *The Growth of Biological Thought: Diversity, Evolution, and Inheritance* (Cambridge: Belknap Press, 1982) and Ernst Mayr and William B. Provine (eds.), *The Evolutionary Synthesis: Perspectives on the Unification of Biology* (Cambridge: Harvard University Press, 1980).
83. These include *Bombay Ducks: An Account of Some of the Every-day Birds* (1906);



*Birds of the Plains* (1908); *Glimpses of Indian birds* (1913); *A Bird Calendar for Northern India* (1916); all of these are available online at <<http://www.archive.org/details/birdcalendarforn00dewarich>>, accessed December 20, 2008. He also wrote *In the Days of the Company* (Calcutta: Bibhash Gupa, 1920, reprint. 1987).

84. (London: The Temside Press, 1961).
85. (Murfreesboro, Tennessee: Dehoff Publications, 1957).
86. Douglas Dewar, *Difficulties in the Evolution Theory* (London: Edward Arnold & Co., 1931) and Douglas Dewar and H. S. Shelton, *Is Evolution Proved?* (London: Hollis and Carter, 1947). This is a debate between Dewar and Shelton, with Arnold Lunn acting as the editor and moderator.
87. *Flaws in the Theory of Evolution*, 228.
88. *Difficulties in the Evolution Theory*, 8-9.
89. *Ibid.*, 67.
90. Theodosius Dobzhansky and Stephen Jay Gould, *Genetics and the Origin of Species* (New York: Columbia University Press, 1982); also see Theodosius Dobzhansky, *Mankind Evolving: The Evolution of the Human Species* (New Haven and London: Yale University Press, 1962); Theodosius Dobzhansky, *Genetics of the Evolutionary Process* (New York: Columbia University Press, 1972); and Theodosius Dobzhansky, *Heredity and the Nature of Man* (New York: Harcourt, Brace & World, 1964).
91. Sharon Kingsland, "Neo-Darwinism and Nature History," in Krige John and Pestre Dominique (eds.) *Science in the Twentieth Century* (Amsterdam: Harwood Academic Publishers, 1997), 417-437.
92. Scientific study of animals, and a branch of zoology.
93. (Cambridge, Massachusetts: Belknap Press, 1975).
94. (Oxford: Oxford University Press, 1976).
95. Primatology is the study of primates. A diverse discipline, it uses data from biology, anthropology, psychology and many other disciplines. Physical anthropology is considered a branch of primatology, which is the primatology of the genus *Homo*, especially *Homo sapiens*. The way Darwinism has become entrenched in all these disciplines can be gleaned from the fact that even the definitions are based on Darwinian assumptions. Thus the above mentioned fields cross over in the study of the hominids, which is defined as a field concerned with "all ape-like ancestors of man and the other great apes". This notion was made popular by *The Ancestor's Tale: A Pilgrimage to the Dawn of Life*, the 2004 book by Richard Dawkins and Yan Wong (London: Weidenfeld & Nicolson), which traces the so-called arrival of humans back "to a common ancestor".
96. S.J. Gould and N. Eldredge, "Punctuated Equilibria: An Alternative to Phyletic Gradualism" in T. Schopf (ed.), *Models in Paleobiology* (San Francisco: Freeman

Cooper and Co. 1973), 82-115.

97. Phyletic gradualism is a macroevolutionary hypothesis rooted in the notion of uniformitarianism (see below). The hypothesis states that species continue to adapt to new challenges over the course of their history, gradually becoming new species. Gradualism holds that every individual is the same species as its parents, and that there is no clear line of demarcation between the old species and the new species. It holds that the species is not a fixed type, and that the population, not the individual, evolves. During this process, evolution occurs at a slow and smooth (but not necessarily constant) rate, even on a geological timescale. Phyletic gradualism has been largely deprecated as the exclusive pattern of evolution by modern evolutionary biologists in favor of the acceptance of occurrence of patterns such as those described on punctuated equilibrium, quantum evolution, and punctuated gradualism. Authors such as Richard Dawkins argue that such constant-rate gradualism is not present in academic literature, serving only as a straw-man for punctuated equilibrium advocates. He refutes the idea that Charles Darwin himself was a constant-rate gradualist, as suggested by Stephen Jay Gould, for Darwin explicitly stated that “Many species when once formed never undergo any further change, but become extinct without leaving modified descendants; and the periods, during which species have undergone modification, though long as measured by years, have probably been short in comparison with the periods during which they have retained the same form. It is the dominant and widely ranging species which vary most frequently and vary most, and varieties are often at first local—both causes rendering the discovery of intermediate links in any one formation less likely. Local varieties will not spread into other and distant regions until they are considerably modified and improved; and when they do spread, if discovered in a geological formation, they will appear as if suddenly created there, and will be simply classed as new species. Most formations have been intermittent in their accumulation; and their duration has probably been shorter than the average duration of specific forms” (*Origin of Species*, 549, fourth edition).
98. The term uniformitarianism was coined in 1832 by William Whewell (1794-1866), the English polymath, scientist, Anglican priest, philosopher, theologian, and historian of science, who also coined the term catastrophism to denote the idea that the Earth had been created through supernatural means and had then been shaped by a series of catastrophic events caused by forces which no longer prevailed. This model contradicted views of gradual, linear, slow evolutionary change.
99. The Cambrian explosion or Cambrian radiation refers to the seemingly rapid appearance of most of the major groups of complex animals around 530 million years ago on the basis of fossil record. This was supposed to have accompanied by a major diversification of other organisms, including animals, phytoplankton (that is, the autotrophic component of the plankton community, which are too small to be individually seen with the unaided eye) and calcimicrobes (the calcareous colonial microfossils, which include many

morphologically dissimilar organisms, whose effect in massive aggregations, in association with shelly metazoans, was to lay down the earliest recognizable reef systems).

100. Strata (sing. stratum), a layer of rock or soil of internally consistent characteristics.
101. Francis Hitching, *The Neck of the Giraffe* (New York: Meridan, 1982), 68.
102. Richard Dawkins, *The Blind Watchmaker* (New York: W.W. Norton & Company, 1986), 87.
103. Ibid.
104. The first description of DNA is ascribed to the Swiss physician Friedrich Miescher, who in 1869 discovered a microscopic substance in the pus of discarded surgical bandages. As it resided in the nuclei of cells, he called it “nuclein” [Dahm R, “Friedrich Miescher and the discovery of DNA”, *Dev Biol* 278 (2) (2005): 274–88]. This was followed by the 1919 discovery of the base, sugar and phosphate nucleotide unit by Phoebus Levene (*J Biol Chem* 40 (2): 415–24). The first X-ray diffraction patterns were produced in 1937 by William Astbury [Astbury W, “Nucleic acid”, in *Symp. SOC. Exp. Bbl* 1 (1947) 66]. In 1928, Frederick Griffith discovered that traits of the “smooth” form of the Pneumococcus could be transferred to the “rough” form of the same bacteria by mixing killed “smooth” bacteria with the live “rough” form [Lorenz MG, Wackernagel W (1994). “Bacterial gene transfer by natural genetic transformation in the environment”, *Microbiol. Rev.* 58 (3): 563–602]. DNA was claimed to carry genetic information by Oswald Avery and his coworkers, Colin MacLeod and Maclyn McCarty in 1943 [*J Exp Med* 79 (2): 137–158]. DNA's role in heredity was confirmed in 1952 through the Hershey-Chase experiment [*J Gen Physiol* 36 (1): 39–56].

The current accepted model is ascribed to James D. Watson and Francis Crick, based on their 1953 article published in *Nature* 171: 737–738. In 1962, after Franklin's death, Watson, Crick, and Wilkins jointly received the Nobel Prize in Physiology or Medicine. In an influential presentation in 1957, Crick laid out the “Central Dogma” of molecular biology, which foretold the relationship between DNA, RNA, and proteins, and articulated the “adaptor hypothesis”. Final confirmation of the replication mechanism that was implied by the double-helical structure followed in 1958 through the Meselson-Stahl experiment [Meselson M, Stahl F (1958). “The replication of DNA in *Escherichia coli*”. *Proc Natl Acad Sci USA* 44 (7): 671–82]. Further work by Crick and coworkers showed that the genetic code was based on non-overlapping triplets of bases, called codons, allowing Har Gobind Khorana, Robert W. Holley and Marshall Warren Nirenberg to decipher the genetic code. These findings represent the birth of molecular biology.

105. (New York: Philosophical Library Inc., 1984).
106. *The Widening Breach: Evolutionism in the Mirror of Cosmology* (Bartlow: Quinta Essentia, 1995).

107. (Washington, D.C.: Regnery Publishing Inc., 1991).
108. For details see <<http://www.fteonline.com>>, accessed December 21, 2008.
109. (Castle Rock, Colorado: Adler & Adler Publishing, 1986).
110. Percival Davis, Dean H Kenyon, *Of Pandas and People* (Richardson: Foundation for Thought and Ethics, 1989).
111. (Washington, D.C.: Regnery Publishing Inc., 1991).
112. (Westmont, IL.: InterVarsity Press, 1995).
113. (New York: Free Press, 1996).
114. (New York: Cambridge University Press, 1998). Also see his more recent work, William A. Dembski and Jonathan Wells, *The Design of Life: Discovering Signs of Intelligence In Biological Systems* (Richardson, Texas: Foundation for Thought and Ethics, 2007).
115. *The Book of Joshua* 10:12-13. Thus the sun and the moon obeyed the command of their Lord, the Creator, rather than laws of physics.
116. For a review of these criticisms see A. D. White, *A History of the Warfare of Science with Theology in Christendom* (New York: D. Appleton and Co., 1897), 2 volumes; reprinted several times since then and available online on several websites.
117. Literary criticism of the Bible which subjected the sacred texts to critical scrutiny from a literary point of view, just as any other ancient text such as the *Odyssey* or the *Iliad*.
118. For an outline of *Essays and Reviews*, see A. R. Vidler, *The Church in an Age of Revolution* (Harmondsworth: Penguin, 1961), chapter 11.
119. Cited in D. Lack, *Evolutionary Theory and Christian Belief* (London: Methuen, 1957), 32.
120. Z. Alszeghi, *Rome and the Study of Scripture: A Collection of Papal Encatments on the Genesis together with the Decisions of the Biblical Commission*, 6th edn. (St. Meinrad: Grail Publication, 1958), 120.
121. "Encyclical letter of His Holiness, Pius XII, Divino afflante spiritu: On the promotion of Biblical studies", in *Foundations of Renewal: Four Great Encyclicals of Pope Pius XII* (New York : Deus Books, Paulist Press, 1961), 64-87.
122. *Ibid.*, emphasis added, 171-186. Also see, F. J. Ewing, "Current Roman Catholic thought on evolution" in S. Tax (ed.), *Evolution after Darwin: The University of Chicago Centennial, Volume III: Issues in Evolution* (Chicago: Chicago University Press, 1960).
123. Complete official text (English translation) of this 1950 Encyclical of Pope Pius XII can be found at <<http://www.ewtn.com/library/encyc/p12human.htm>>, accessed December 25, 2008.
124. *Le Monde*, October 25, 1996, 17.
125. C. Holden, "The Vatican's Position Evolves", *Science* 272, 1996, 717.

126. A. Abbot, in *Nature*, 383, 1996, 717.
127. C. Holden, “The Vatican’s Position Evolves”, *Science* 274, 1996, 717.
128. C. Holden, *Science*, op.cit.
129. The complete text of Pope’s address is available at <<http://www.cin.org/users/james/files/message.htm>>, accessed December 25, 2008.
130. See, for example, Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1970), and also his *The Essential Tension* (Chicago: University of Chicago Press, 1977), and J. Evola, *Revolt against the Modern World* (Rochester: Inner Traditions, 1995).
131. *Sophia*, Vol. 3 (1997) No. 1, 60.
132. *Ibid.*, 61.
133. Asa Gray, *Darwiniana: Essays and Reviews pertaining to Darwinism* (Dearborn: Scholarly Publishing Office, University of Michigan Library, 2006), originally published in 1876). Also see his review of *The Origin* in *Atlantic Monthly*, first published in 1860 in which he said: “We should advise Mr. Darwin to assume, in the philosophy of his hypothesis, that variation has been led along certain beneficial lines.”
134. Fredrick Temple, *The Relations between Religion and Science: Eight Lectures preached before the University of Oxford in the Year 1884* (London: Macmillan, 1884), republished several times, including one edition by web-based Indy-Publish.com, 2006, 119.
135. *Ibid.*, 2.
136. (Cambridge: Harvard University Press, 1998).
137. <[http://www.ctns.org/russell\\_article.html](http://www.ctns.org/russell_article.html)>, accessed December 28, 2008.
138. Russell mentions the following for a review of positions taken in the nineteenth century: Claude Welch, *Protestant Thought in the Nineteenth Century* (New Haven: Yale University Press, 1985), 315; and Ian G. Barbour, *Issues in Science and Religion* (New York: Harper & Row, 1971, originally published in 1966 by PrenticeHall), Ch. 4. For more denominationally focused articles on evolution and theology see the articles by Jürgen Hübner, Arthur Peacocke and Schmitz-Moormann in Svend Andersen and Arthur Peacocke (eds.), *Evolution and Creation: A European Perspective* (Aarhus: Aarhus University Press, 1987). Also helpful is David C. Lindberg and Ronald L. Numbers (eds.), *God and Nature: Historical Essays on the Encounter Between Christianity and Science* (Berkeley: University of California Press, 1986). See also Niels H. Gregersen, Ulf Gorman and Christoph Wassermann (eds.), *Studies in Science & Theology 1997: Yearbook of the European Society for the Study of Science and Theology*, vol. 5, *The Interplay Between Scientific and Theological Worldviews, Part I* (Geneva: LABOR ET FIDES, S. A., 1999).
139. Arthur Peacocke, “Genetics, Evolution, and theology”, in Ted Peters (ed.), *Science & Theology: The New Consonance* (Boulder: Westview Press, 1998), 197.

140. Arthur Peacocke, *Creation and the World of Science: The Bampton Lectures* (Oxford: Clarendon Press, 1979); also see his *Intimations of Reality: Critical Realism in Science and Religion: The Mendenhall Lectures* (Notre Dame: University of Notre Dame Press, 1984), and *Theology for a Scientific Age: Being and Becoming Natural, Divine and Human, Enlarged Edition* (Minneapolis: Fortress Press, 1993); see also Robert John Russell, "The Theological Scientific Vision of Arthur Peacocke," in *Zygon* 26.4 (December 1991): 505-17.
141. Philip Clayton, *God and Contemporary Science* (Grand Rapids: Wm. B. Eerdmans Publishing Company, 1997). Clayton's view of Christian pantheism is also found in his article, "The Case for Christian Pantheism" in *Dialog* 37.3 (Summer 1998). Also see the series of responses to this article and Clayton's response to them in the Fall 1999 issue of *Dialog*.
142. I. G. Barbour, *Issues in Science and Religion* (New York: Harper & Row, 1971), originally published in 1966 by PrenticeHall.
143. *Ibid.*
144. Wolfgang Smith, "The Extrapolated Universe", *Sophia*, vol. 6, no. 1, Summer 2000, 7-36.
145. *Ibid.*, 7.
146. *Ibid.*, 8.
147. *Ibid.*, 8, emphasis in the original.
148. *Ibid.*, 34.
149. Percival Davis and Dean H. Kenyon, *Of Pandas and People* (Richardson: Foundation for Thought and Ethics, 1989).
150. Many contemporary writers have pointed out this difficulty. For example, see "Evangelicals Inheriting the Wind: The Phillip E. Johnson Phenomenon", by Danis O. Lamoureux in Phillip E. Johnson and Denis O. Lamoureux et al, *Darwinism Defeated?* (Vancouver: Regent College Publishing, 1999), 10.
151. See "Introduction" in William Dembski (ed.), *Mere Creation* (Downers Grove: InterVarsity Press, 1998), 9.
152. Rabbi Hillel Goldberg, "Genesis, Cosmology and Evolution" in *Jewish Action*, summer 5769/2000, 2.