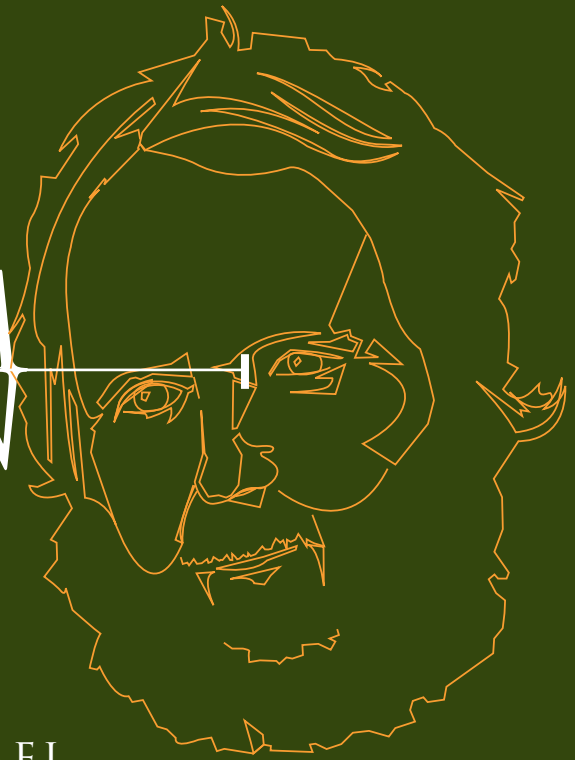
DARWINISM & SCIENCE

A MARRIAGE MADE IN HEAVEN?



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MICHAEL RUSE

LUCYLE T. WERKMEISTER PROFESSOR OF PHILOSOPHY,
FLORIDA STATE UNIVERSITY

THE HERBERT H. REYNOLDS LECTURESHIP IN THE HISTORY AND PHILOSOPHY OF SCIENCE

The Herbert H. Reynolds Lectureship in the History and Philosophy of Science

Darwinism and Atheism:
A Marriage Made in Heaven?

by Dr. Michael Ruse
Florida State University

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The Herbert H. Reynolds Lectureship in the History and Philosophy of Science, established in 1998 by a gift to the Baylor University Department of Philosophy from the Herbert H. and Joy C. Reynolds Endowment Fund for University Excellence, brings to the Baylor University campus an internationally recognized scholar in the sciences or in the philosophy or history of science.

DARWINISM AS RELIGION: ARE THE CREATIONISTS RIGHT?

DR. MICHAEL RUSE

Q: Dr. Ruse, having examined the creationist literature at great length, do you have a professional opinion about whether creation science measures up to the standards and characteristics of science that you have just been describing?

A: Yes, I do. In my opinion, creation science does not have those attributes that distinguish science from other endeavours.

Q: Would you please explain why you think it does not?

A: Most importantly, creation science necessarily looks to the supernatural acts of a Creator. According to creation-science theory, the Creator has intervened in supernatural ways using supernatural forces.

Q: Do you think that creation science is testable?

A: Creation science is neither testable nor tentative. Indeed, an attribute of creation science that distinguishes it quite clearly from science is that it is absolutely certain about all of the answers. And considering the magnitude of the questions it addresses — the origins of man, life, the earth, and the universe - that certainty is all the more revealing. Whatever the contrary evidence, creation science never accepts that its theory is falsified. This is just the opposite of tentativeness and makes a mockery of testing.

Q: Do you find that creation science measures up to the methodological considerations of science?

A: Creation science is woefully lacking in this regard. Most regrettably, I have found innumerable instances of outright dishonesty, deception, and distortion used to advance creation science arguments.

Q: Dr. Ruse, do you have an opinion to a reasonable degree of professional certainty about whether creation science is science?

A: Yes.

Q: What is your opinion?

A: In my opinion creation science is not science.

Q: What do you think it

is?

A: As someone also trained in the philosophy of religion, in my opinion creation science is religion. (Ruse 1988, 304-6)

My moment of triumph! The time was December 1981 and the place was Little Rock, Arkansas. The occasion was a court trial, brought on by the American Civil Liberties Union, the organization dedicated to the defense of the U.S. Constitution. It was attacking a new law in the state that insisted that children be taught, alongside evolution, something called (by its defenders) creation science and better known to the rest of us as Genesis taken absolutely literally. I was an expert witness for the ACLU, and thanks to my testimony and that of and others (notably including the late Stephen Jay Gould) we won a terrific victory. Creation science was ruled to be religion and hence not admissible to publicly funded schools, and that was the end of that. For once in his life, a philosopher had shown that he was not entirely useless.

That was 20 years ago, and time has shown that we evolutionists celebrated a little too quickly. Crude Biblical literalism may have been vanquished, but an evangelical-Christian-inspired approach to nature is still alive and well — these days often under the label of Intelligent Design — and evolutionists continue to have to fight for the theory that they love so deeply. Anyone who says confidently that the schoolchildren of the United States will never learn about Noah's flood in biology classes in the 21st century sees ahead more clearly and confidently than I. The usual feeling of evolutionists — certainly the feeling that I had for many years before, during, and after Arkansas — is that it is a simple matter of right and wrong, black and white. The Christians are wrong and the evolutionists are right. The world was not made in six days, 6,000 years ago. Adam and Eve were not made miraculously. There was no universal flood. Rather, everything living is the end result of a long, slow, natural process of development, and (although there is some debate about its extent) the chief

cause is that identified by Charles Darwin in his Origin of Species: natural selection brought on by a struggle for existence.

I still think that this is basically the truth, and please note that nothing I am about to say in any way should be taken as a weakening of my convictions in this respect. I am with Darwin all of the way. I agree with the philosopher Dan Dennett (1995), who has said that natural selection is the great idea of all time. But I do think now that there is more to the story than good and bad, heaven and hell. I believe — and in this talk I shall try to justify this belief — that there is a good reason why, over and above the simple facts of the case, the evangelicals are tense about Darwinism (using the term generically for evolutionism). As an evolutionist, I look to the past for solutions and understanding, and I believe that by looking back at the history of evolution we see that it has always been more than just science — and continues to be more to this day — and that this excess is of a kind directly to challenge those with religious convictions. In short, I argue that evolution has itself (and still does) function as a challenge to conventional religion — it is, if you will, a secular religion — and there is no wonder that the creationists and fellow travelers get so het up. I am not the first to say this. The creationists have been saying it for some time. But I think I am the first — or one of the first — to say it from the evolutionary side. I am not a traitor — at least, I do not think of myself in this way — even though I am saying naught for our comfort. Without wanting to sound like a pretentious prig, my hope indeed is to show to us evolutionists what we are doing. I do not expect or really want people to change their minds about their beliefs, but I do want to show when it is appropriate to make claims of one kind and when it is appropriate to make claims of another kind. And when perhaps we should keep our mouths shut, although there are no doubt those who think that I should be the first to take my own advice.

BEFORE THE "ORIGIN"

Evolution is an idea with its roots in the 18th century. This was the time when the ideology of progress — the belief that humans through their own unaided efforts can change and improve their lots — became dominant, and there were several who took the cultural idea of progress and read it into the rocks, thereby making for an evolutionary or transmutationary view of life's history. Usually, they then promptly took their evolutionism and argued in a good circular fashion that this justified their beliefs in progress! Entirely typical was Charles Darwin's grandfather, Erasmus Darwin. A physician in the British Midlands in the second half of the 18th Century, he was carried along by the first wave of the Industrial Revolution, as enterprising engineers put to use the powers of coal and steam in the running of those machines which were to produce finished goods at a rate far more rapid than could ever be achieved by hand. Apparently much influenced by the fossils revealed when once he took a trip into the cuttings for a new canal tunnel — "I have lately travel'd two days journey into the bowels of the earth, with three most able philosophers, and have seen the Goddess of Minerals naked, as she lay in her inmost bowers" (letter to Josiah Wedgwood, July 2, 1767, King-Hele 1981, 43) — Erasmus Darwin moved readily from a belief in social and industrial progress to one of progress in the organic world. Evolution from the primitive to the complex, from "monad to man" as the popular phrasing had it, from monarch (butterfly) to monarch (king) as he himself once put it. "Would it be too bold to imagine, that all warm-blooded animals have arisen from one living filament, which the great first cause endued with animality, with the power of acquiring new parts, attended with new propensities, directed by irritations, sensations, volitions, and associations; and thus possessing the faculty of continuing to improve by its own inherent activity, and of delivering down those improvements by generation to its posterity, world without end?"

(Darwin 1801, 2, 240).

Happy always to express his sentiments in florid verse, Erasmus Darwin broke forth on the joys and triumphs of evolutionary progress. Above all, there was the special position of humankind.

Imperious man, who rules the bestial crowd,
Of language, reason, and reflection proud,
With brow erect who scorns this earthy sod,
And styles himself the image of his God;
Arose from rudiments of form and sense,
An embryon point, or microscopic ens!

(Darwin 1803, 1, Canto I, lines 309-14.)

Not that we should think that humans succeed by force or superior senses of sight or touch or whatever. It is our reason that counts, together with other related organs like our hands.

Proud Man alone in wailing weakness born,
No horns protect him, and no plumes adorn;
No finer powers of nostril, ear or eye,
Teach the young Reasoner to pursue or fly.–
Nerved with fine touch above the bestial throngs,
The hand, first gift of Heaven! to man belongs.

(Canto III, lines 117-22)

And this is all the end product of the progressive development of our intelligences, which cause and are reflected in our scientific achievements.

How loves and tastes, and sympathies commence
From evanescent notices of sense;
How from yielding touch and rolling eyes
The piles immense of human science rise!

(Canto III, lines 43-6)

Now I am not really interested here in the causal speculations that Erasmus Darwin advanced for his evolutionism. In fact, he rather favoured some kind of inheritance of acquired characteristics — the process that came to be known as Lamarckism, after the French evolutionist who wrote a decade or two later than Erasmus Darwin. And I am certainly not in any sense implying

that he was putting forward a theory that he thought of as atheistical, not merely going against Christianity but against a god of any kind. In fact, like many intellectuals at the end of the Eighteenth Century (including the first presidents of the United States), Erasmus Darwin was a deist — denying the Trinity and believing in God as an unmoved mover. The point rather was that he saw his evolutionism as part and parcel of his religious position, the one reinforcing and in turn being reinforced by the other. He saw the highest mark of God's power and glory not in divine interventions, miracles, but precisely in the fact that these are not needed. God can do everything through unbroken law. To use a modern metaphor: God has preprogrammed the world so that further intervention is unneeded. Evolution, the triumph of unbroken law, can therefore be seen as the ultimate climax of the divine creation — the proof above all else of God's standing and worth. Everything is planned beforehand and goes into effect through the laws of nature. In Darwin's (1801) own words: "What a magnificent idea of the infinite power of the great architect! The cause of causes! Parent of parents! Ens entium!" (2, 247)

What is significant for our tale is that critics of evolution saw what was going on, and criticized it for this very reason. By the beginning of the 19th Century sophisticated thinkers were moving on beyond a crude biblical literalism — the fossils and the rocks persuaded people that the history of the world is too long to be constrained by the genealogies of Genesis and that the denizens of the past are too varied and magnificent simply to be drowned in the Deluge — but they could see exactly why it would be unacceptable to a Christian. For the Protestant particularly, the hope of salvation lies in and only in God's unmerited Grace. We are unworthy but God takes pity on us and offers us the hope of eternal life. Providence is merciful. Evolution, with its backbone of progress, suggested that humans through their own unaided efforts can improve things.

And this is heresy. Hence, although the critics of evolution certainly went after what they thought of as the scientific errors in evolutionism — gaps in the fossil record and that sort of thing — in respects they were more concerned to counter what they saw as its unacceptable, anti-Christian philosophy. The father of comparative anatomy, the great Frenchman George Cuvier (a Protestant despite his nationality) was typical. He savaged people like Lamarck on straight scientific grounds — how could one argue for evolution when the mummified animals brought back by Napoleon from Egypt are exactly the same species as those living and thriving today? But then he went after them as irreligious. How can one be an evolutionist and thus ignore — because one is thus appealing to a causal process governed by blind, undirected law — the evidence of God's hand in the creation? How can one ignore the functioning nature of organisms, as (with some justification) Cuvier felt that people like Lamarck were wont to do? For Cuvier, this was the key to understanding nature.

Natural history nevertheless has a rational principle that is exclusive to it and which it employs with great advantage on many occasions; it is the conditions of existence or, popularly, final causes. As nothing may exist which does not include the conditions which made its existence possible, the different parts of each creature must be coordinated in such a way as to make possible the whole organism, not only in itself but in its relationship to those which surround it, and the analysis of these conditions often leads to general laws as well founded as those of calculation or experiment. (Cuvier 1817, 1, 6; quoted in Coleman 1964, 42)

And then, above all else, there is that dreadful appeal to progress, something that (as a Protestant) Cuvier abhorred, and as a servant of the state (and thinking that it was a philosophy that led to the Revolution) Cuvier feared. Against evolution, Cuvier saw no natural progress, no natural development

of organisms. Rather, he supposed that every now and then organisms get wiped out by floods (of which, on historical grounds Noah's may have been the last although not universal) and then they reinvade from other parts of the globe. "I do not pretend that a new creation was required for calling our present races of animals into existence. I only urge that they did not occupy the same places, and that they must have come from some other part of the globe" (Cuvier 1813, 125-126).

My point then is that early evolutionism was less a functioning empirical science — Erasmus Darwin was positively cavalier on empirical matters and Lamarck was not a whole lot better — and more a vehicle for a philosophy of deism-cum-progress. It was a challenge to Christianity, but for this reason rather than on strictly literalist grounds. Moreover, it was seen to be what it was. And this was a state of affairs that persisted until the middle of the 19th Century. The best known evolutionary tract was the "Vestiges of the Natural History of Creation" (1844), authored anonymously by (whom we now know to be) the Scottish publisher Robert Chambers. It was openly and flamboyantly progress endorsing, and backed by a Calvinist-deist view of the deity. And it was attacked in these terms. People like Adam Sedgwick, professor of geology at the University of Cambridge and deeply committed, ardent Anglican, loathed and detested its message, thinking it the epitome of false religion — which of course from his perspective it was. At the same time, one should point out that there were those who loved the message of Vestiges precisely because of its message, one that either they held in its own right or that they managed to blend into their own readings of the gospel story. The poet Alfred Tennyson incorporated many of Chambers's ideas into his famous and much-loved poem "In Memoriam." This poem was begun in the 1830s but not completed until about 1850. It is a testament to the memory of a young friend of Tennyson, Arthur Hallam, whose life was cut

short. Tennyson writes at first in the poem about his desolation at Hallam's death and existence's apparent meaninglessness, something that he found reflected in the uniformitarian geology of Charles Lyell. Lyell had argued that nature is going nowhere, just simply bound by unbroken stern laws, and that there is no end in prospect, nor any progress in view. Life comes and life goes without meaning as expressed in the following famous passage:

Are God and Nature then at strife,
That Nature lends such evil dreams?
So careful of the type she seems,
So careless of the single life;
.....
So careful of the type? but no.
From scaped cliff and quarried stone
She cries, 'A thousand types are gone:
I care for nothing, all shall go.'

Given Nature "red in tooth and claw" — this is the source of this famous phrase — nothing seems to make any sense. Not only individuals are pointless mortals, but so also are groups. We are born, we live, and then we die — usually painfully. Nothing makes sense or has meaning. There are just endless Lyellian cycles. Then towards the end of the 1840s Tennyson read Chambers, or at least he read a very detailed review of Chambers's "Vestiges." Chambers argued for an organic evolution which was unambiguously progressionist, that is to say moving up from simple forms up to humans, and then perhaps beyond. Inspired by this, Tennyson picked up pen and finished his poem. He argued in the final lines that perhaps there is meaning after all, despite a Lyellian uniformitarianism: that life is progressing upwards, and that perhaps will go on beyond the human form that we have at present. Could it not be that Hallam represented some anticipation of the more-developed life to come, cut short as it were in its prime? There is therefore hope for us all and a meaning for the life of Hallam.

A soul shall strike from out the vast
And strike his being into bounds,

And moved thro' life of lower phase,
Result in man, be born and think,
And act and love, a closer link
Betwixt us and the crowning race
.....
Whereof the man, that with me trod
This planet, was a noble type
Appearing ere the times were ripe,
That friend of mine who lives in God.

CHARLES DARWIN

So much for evolution before 1859, the year in which the Origin of Species was published. What did Darwin do and how did he alter things? Start with what he did. He set out to give a new theory of evolution, one that could indeed stand muster against a proper empirical approach to science. He made the fact of evolution secure and he proposed the mechanism — natural selection — that is today by scientists generally considered the key factor behind the development of organisms. A development by a slow natural process from a few simple forms, and perhaps indeed ultimately from inorganic substances (although, sagely, Darwin said nothing on this latter topic). In the Origin, after first stressing the analogy between the world of the breeder and the world of nature, and after showing how much variation exists between organisms in the wild, Darwin was then ready for the key inferences. First, an argument to the struggle for existence and, following on this, an argument to the mechanism of natural selection.

A struggle for existence inevitably follows from the high rate at which all organic beings tend to increase. Every being, which during its natural lifetime produces several eggs or seeds, must suffer destruction during some period of its life, and during some season or occasional year, otherwise, on the principle of geometrical increase, its numbers would quickly become so inordinately great that no country could support

the product. Hence, as more individuals are produced than can possibly survive, there must in every case be a struggle for existence, either one individual with another of the same species, or with the individuals of distinct species, or with the physical conditions of life. It is the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms; for in this case there can be no artificial increase of food, and no prudential restraint from marriage. (Darwin 1859, 63)

Now, natural selection follows at once.

Let it be borne in mind in what an endless number of strange peculiarities our domestic productions, and, in a lesser degree, those under nature, vary; and how strong the hereditary tendency is. Under domestication, it may be truly said that the whole organization becomes in some degree plastic. Let it be borne in mind how infinitely complex and close-fitting are the mutual relations of all organic beings to each other and to their physical conditions of life. Can it, then, be thought improbable, seeing that variations useful to man have undoubtedly occurred, that other variations useful in some way to each being in the great and complex battle of life, should sometimes occur in the course of thousands of generations? If such do occur, can we doubt (remembering that many more individuals are born than can possibly survive) that individuals having any advantage, however slight, over others, would have the best chance of surviving and of procreating their kind? On the other hand we may feel sure that any variation in the least degree injurious would be rigidly destroyed. This preservation of favourable variations and the rejection of injurious variations, I call Natural Selection. (Pp. 80-81)

With the main mechanisms of change thus presented, Darwin introduced the famous metaphor of a tree. "The affinities of all the beings of the same class have sometimes been represented by a great tree. I believe this simile largely speaks the truth." The leaves and twigs at the top represent the species

extant today. Then as we go down the branches, we have the great evolutionary paths of yesterday. All the way down we go until we reach the very first shared origins of life. “As buds give rise by growth to fresh buds, and these, if vigorous, branch out and overtop on all sides many a feebler branch, so by generation I believe it has been with the great Tree of Life, which fill with its dead and broken branches the crust of the earth, and covers the surface with its ever branching and beautiful ramifications” (Darwin 1859, 129-130).

Then from this, Darwin turned to a general survey of the biological world, offering what the philosopher William Whewell (1840) had dubbed a “consilience of inductions.” Each area was explained by evolution through natural selection and in turn each area contributed to the support of the mechanism of evolution through natural selection. Geographical distribution (biogeography) was a triumph, as Darwin explained just why it is that one finds the various patterns of animal and plant life around the globe. Why, for instance, does one have the strange sorts of distributions and patterns that are exhibited by the Galapagos Archipelago and other island groups? It is simply that the founders of these isolated island denizens came by chance from the mainlands, and once established started to evolve and diversify under the new selective pressures to which they were now subject. Embryology likewise was a particular point of pride for Darwin. Why is it that the embryos of some different species are very similar — man and the dog for instance — whereas the adults are very different? Darwin argued that this follows from the fact that in the womb the selective forces on the two embryos would be very similar — they would not therefore be torn apart — whereas the selective forces on the two adults would be very different — they would be torn apart. Here, as always through his discussions of evolution, Darwin turned to the analogy with the world of the breeders in order to clarify and support the point at hand.

"Fanciers select their horses, dogs, and pigeons, for breeding, when they are nearly grown up: they are indifferent whether the desired qualities and structures have been acquired earlier or later in life, if the full-grown animal possesses them" (Darwin 1859, 446). And finally, all of this led to that famous passage at the end of the Origin: "There is a grandeur in this view of life, with its several powers, having been originally breathed into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms, most beautiful and most wonderful have been, and are being, evolved." (Darwin 1859, 490)

So much for the theory. Now, in the light of the history thus-far presented, what was Darwin hoping to do? Two things we can say immediately. He was not repudiating progress. It may have had a somewhat subdued role, but as the quotation just given at the end of the last paragraph shows unambiguously, biological progress was there and believed in. And as later works like the Descent of Man showed very well, this biological progress was much bound up with a general belief in social and cultural progress. "In all civilized countries man accumulates property and bequeaths it to his children. So that the children in the same country do not by any means start fair in the race for success. But this is far from an unmixed evil; for without the accumulation of capital the arts could not progress; and it is chiefly thorough their power that the civilised races have extended, and are now everywhere extending, their range, so as to take the place of the lower races" (Darwin 1871, 1, 169). More than this. It is pretty clear that at the time of the writing of the Origin, Darwin subscribed to a deistic view of nature and the universe. To his American friend, Asa Gray, Harvard botanist and ardent Christian, Darwin wrote:

"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 shd. 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 Ichneumonidae 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." (Letter to Asa Gray, May 22, 1860)

And indeed, we can point to the Christian influences on Darwin's thinking. Adaptation, the phenomenon for which natural selection is supposed, is something that had been stressed by natural theologians from the time of Aristotle. Darwin got a full blast as a student when at Cambridge and he had to read Archdeacon Paley's Natural Theology, with the eye taken as a proof of the existence of God. "I know no better method of introducing so large a subject, than that of comparing a single thing with a single thing: an eye, for example, with a telescope" (Paley 1802, 14). Then as he moved to natural selection, Darwin grasped that artificial selection can bring about an equivalent of adaptation. The question was how artificial selection was to be transferred to the wild. It was when Darwin read Malthus (1826), who argued that food and space supplies are exhausted by potential population growth and

hence there is a struggle for existence, which Darwin then realized that he had in his grasp the missing part of his theory. But note that Malthus's position, although it sounds harsh (it is harsh!) is cast in a Christian framework. Without the spur of the struggle, no one would be inclined to work. God therefore put it in place deliberately for our own good.

So I am certainly not saying that Darwin broke absolutely with his past. Indeed, in a way I am hinting that if someone were a Christian perhaps, for the first time, here was an evolutionary theory that might be molded and adapted for use without giving up one's faith. But, in the context of this present discussion, I think more important than the continuities was Darwin's determination to make of his theory something with a different status from those of his predecessors. Darwin did not want to produce a secular religion. He wanted to produce a functioning, empirical science. He wanted something, to use the language of Thomas Kuhn (1962), that could work as a "paradigm," making possible normal science. The kind of normal science that in fact he himself was to do soon after the Origin, when he wrote a little book on orchids (Darwin 1862) and that others were to do, like Henry W. Bates (1862) when he used natural selection to produce an explanation of butterfly mimicry. Progress was there, but it was downplayed. References may have been made to the Creator, but He was given no work to do, and could have been dropped without loss of content. Evolution through natural selection was certainly going to contradict Genesis taken literally, but to think that Darwin was offering a "religion without revelation" (to borrow a title from a book of the 20th century) would be quite to misunderstand his intent.

THE DARWINIAN EVANGELIST

So, what happened? I argue — and this is the most crucial point of my talk — that Darwinism got highjacked, and turned

to other purposes. And the chief highjacker was none other than he who is celebrated as “Darwin’s Bulldog,” the 19th century morphologist and paleontologist Thomas Henry Huxley. Unlike Darwin — a rich man, sick for most of his adult life, able to live as a semi-recluse — Huxley was a man who was making his own way, as a university professor and then as a college dean. He, with a number of others (mainly men but with some women like Florence Nightingale) were striving hard to change the course of British life, away from the near-feudalism of the rural 18th century and towards the modern, urban industrialism of the 20th century. They were reforming the civil service, the military, the medical profession, and more — including teaching at school and university. Huxley was in the thick of creating a professional science — a professional science where one could succeed on merit and make a living — and Huxley realized full well that to achieve his aims he had to find reasons to employ the young scientists he was producing. Physiology he sold to the medical profession, arguing (with success) that the time had come to stop killing people and to start curing. Morphology he sold to the teaching profession, something at a crucial point for only now was education starting to become the birthright of all and not under the sway of organized religion. For evolution, alas, Huxley could see no immediate cash value. It cured no pains in the belly, and it was too daring for the junior classroom. But Huxley — a dedicated evolutionist, albeit somewhat indifferent to natural selection — could nevertheless see a role for evolution. It would be the ideology — the secular religion — of the reformers, being something to put against the ideology — the spiritual religion — allied with those who resisted change. It would be the system giving answers to origins and explaining the status of humankind to replace the outdated system of the conservatives and reactionaries, who worshiped each Sunday in the local Anglican parish

church. Evolution versus Christianity.

Progress, naturally, was to be the backbone of the system. But more was needed. A good religion has a moral system, a set of ethical prescriptions — Thou shalt not kill; Love your neighbour as yourself; and that sort of thing. Charles Darwin was not really into this sort of thing, but there was another English evolutionist ready and very willing to step into the breach. Herbert Spencer's evolutionism starts (continues and finishes) with progress. For him, progress was not so much an empirical finding but a metaphysical presupposition of his view of history. It ran through everything, from the most primitive forms of culture to the evolution of our own species.

Now, we propose in the first place to show, that this law of organic progress is the law of all progress. Whether it be in the development of the Earth, in the development of life upon its surface, in the development of society, of government, of manufactures, of commerce, of language, literature, science, art, this same evolution of the simple into the complex, through successive differentiations, holds throughout. From the earliest traceable cosmical changes down to the latest results of civilization, we shall find that the transformation of the homogeneous into the heterogeneous, is that in which progress essentially consists. (Spencer 1857, 2-3)

What about causes? Never that interested in natural selection in the biological world, Spencer showed an eclectic synthesis of German morphology and British thermodynamics, seasoned with a good dash of British non-conformist thinking on society and the desirable underlying economic forces, arguing (perhaps more metaphysically than empirically) that nature starts in a condition of uniformity — what he called "homogeneity" — and tends naturally to a condition of complexity — what he called "heterogeneity." Why should this be so? Apparently it follows directly from the fact that causality tends to be open ended, inasmuch

as one cause leads to multiple effects, rather than many causes leading to one effect. There is always a kind of explosion or expansion outwards, as the simple and uniform tends to the complex and diverse. This happens at all levels of the hierarchy — organisms, states, whatever. Something internal or external jogs or disturbs the state of being, and the multiplying causal process kicks in. More than this however, for as the process of complexification is occurring, there is a tendency to move upwards to a higher level of existence. Life — everything — is rather like the incoming tide, set on its end. There are surges forward, followed by moments or periods of consolidation, then further surges forward, with overall gain happening over and over again. Disturbance leads to the attempt to move back to a state of rest, but the new state is never that of the old state – it is more heterogeneous, and higher. Overall, therefore, evolution can be described (as it came to be known) as an exemplification of "dynamic equilibrium."

Morality fit nicely into all of this. It is our obligation to preserve and to promote progress. Here there is a place for the struggle and selection. Even in 1852, some years before the Origin was published, Spencer speculated on selective effects showing themselves in the different natures and behaviours of the Irish and the Scots. He concluded that struggle and selection in society translates into extreme laissez faire socioeconomics: the state should stay out of the way of people pursuing their own self-interests and should not at all attempt to regulate practices or redress imbalances or unfairnesses. Libertarian license therefore is not only the way that things are but the way that they should be. In fact, Spencer was far from convinced that mid-Victorian Britain was a laissez faire society, but this is what he hoped fervently that it would become.

We must call those spurious philanthropists, who, to prevent present misery, would entail greater misery upon

future generations. All defenders of a Poor Law must, however, be classed among such. That rigorous necessity which, when allowed to act on them, becomes so sharp a spur to the lazy and so strong a bridle to the random, these pauper's friends would repeal, because of the wailing it here and there produces. Blind to the fact that under the natural order of things, society is constantly excreting its unhealthy, imbecile, slow, vacillating, faithless members, these unthinking, though well-meaning, men advocate an interference which not only stops the purifying process but even increases the vitiation — absolutely encourages the multiplication of the reckless and incompetent by offering them an unfailing provision, and discourages the multiplication of the competent and provident by heightening the prospective difficulty of maintaining a family. (Spencer 1851, 323-4)

In fact, matters were rather more complex than this. Just as Christians can differ morally in the name of their Saviour — the battalion padre preaching fire and brimstone while the Quaker embraces pacificism — so followers of Spencer (who tended, somewhat inaccurately to be called "Social Darwinians") could differ in their prescriptions. Spencer himself was far from denying the worth of any individual charity. It was rather state-supported institutions of charity that he opposed. The same is true very much of his followers. John D. Rockefeller the first, the founder of Standard Oil and one of the notorious business men at the beginning of this century, was openly in favor of denying state interference: he spent much of his time opposing the federal government as it strove to break up the monopoly he had established over the distribution and sale of fuel oil. He justified himself in Darwinian terms, saying that the fit do and should survive. Yet from the beginning he had tithed himself and always gave deeply to charity. Likewise Spencer enthusiast Andrew Carnegie, founder of U.S. Steel, who claimed that no rich man should die

rich. He gave much to the founding of public libraries. Interestingly here we see the direct input of a kind of Darwinism. Carnegie was less interested in stressing the downside of laissez faire — the failure of the unfit — than in stressing the upside — the success of the fit. Public libraries were places where the poor-but-gifted child could go and thereby improve themselves and raise themselves up in society (Bannister 1979; Russett 1976).

These are details. Fascinating details, but details nevertheless. The point I make is that Charles Darwin was both a success and a failure. He was a success inasmuch (and it is a very big "inasmuch") as he turned people to evolution. Before him, it had been a pseudo-scientific idea, on a par with astrology or phrenology. (Interestingly, Chambers had started to write a book on phrenology — the science of brain bumps — and changed half way through to writing a book on evolution.) After Darwin, evolution was common sense. He was a failure inasmuch (and you judge how big an "inasmuch" you think this to be) he did not turn evolution into a functioning, professional science, with natural selection at its heart. Evolution was a raging success, but more in a bastardized Spencerian version, functioning less as a science and more as a secular religion. That was what the reformers like Huxley wanted and that was what the reformers like Huxley got. When Jesus died on the cross, there was no religion of Christianity. That was for St. Paul to create, and people have been arguing ever since about the relationship between that life and teachings of Jesus and the religion that St. Paul left behind. When Darwin wrote the Origin, there was no science of Darwinism. That was for Thomas Henry Huxley to create, and I argue that the relationship between the teachings of Darwin and the religion of Huxley was about as iffy as that between Jesus and Paul.

THE SYNTHETIC THEORY

The 1930s saw the coming of Mendelian genetics generalized to populations, and with this

it was possible to build a new Darwinism, one based on selection and a new and thriving theory of heredity. And with the intellectual advances came a determination by the supporters of this "synthetic theory" (a synthesis of Darwin and Mendel) to produce a functioning, mature, professional science of evolution. More than this. The determination came to fruition. Thanks to people like the Russian-born Theodosius Dobzhansky in America and E.B. Ford and his school of ecological genetics in England, Darwin's dream was realized. Perhaps slowly at first, but then with gathering speed, a selection-based, experiment- and observation-driven science of evolution came into being. One can mention Dobzhansky's Genetics and the Origin of Species (1937), Ford's Ecological Genetics (1964), as well as ornithologist Ernst Mayr's Systematics and the Origin of Species (1942), mammalian paleontologist George Gaylord Simpson's Tempo and Mode in Evolution (1944), and botanist G. Ledyard Stebbins's Variation and Evolution in Plants (1950). But here is the fascinating point. Every one of these people, and indeed the theoretical population geneticists (notably the English R.A. Fisher (1930) and the American Sewall Wright (1931, 1932)) on which the synthetic theorists based their empirical studies, was drawn first to evolution because it was a secular religion! Or at least (especially in the cases of Fisher and Dobzhansky) because it had the makings of a revitalization of the Christianity to which they subscribed already. They liked the idea of progress and they liked the idea of evolution yielding moral prescriptions. They did not want to give up on the extra-scientific side of evolutionism.

So what were they to do? They wrote two sets of books. One set, dead straight and professional, with nary a hint of progress and so forth. Then another set, based on the first set, with the mathematics removed (not much work here, to be candid), with a couple of chapters on progress, morality, and the American

way (or whatever), and a disarming preface telling you that this is for the "general reader." Simpson, probably the brightest of the lot, was a paradigm. Tempo and Mode in Evolution (1944) is so po-faced it is almost boring. The same is true of the revision, The Major Features of Evolution (1953), that appeared some nine years later. But in the middle came, The Meaning of Evolution (1949), and if the title does not give away the secret then the contents do. There was masses of stuff on progress and on the implications of all of this. In fact, Simpson ran through a large number of proposed criteria of biological improvement or worth: expansion of life, dominance, specialization, potential for future development, independence from the environment, control of the environment, complexity, general energy level, pre- and post-natal care, sophisticated nervous system, individualization, and more. Humans certainly do not come out top on all of these. For instance, Simpson thought that we humans are not very specialized. However, overall, we tend to score well, the very best in many cases — like dominance and pre-and post-natal care and nervous system and individualization. And this general consilience seems to have been enough to convince Simpson that progress, with humans at the top, was more than just a whim or conceit. Progress may not be entirely objective, but it was more than just one man's yearning.

Move to ethics. Simpson was absolutely and completely committed to the view that ethics is natural, in the sense of being produced by evolution. Simpson argued that biology, through the medium of selection, could produce something like an ethical sense, pointing out that success in the struggle for existence does not necessarily mean all-out warfare, but can demand sympathetic alliance with one's fellows. Ethics is natural also in having no justification or sanction outside of evolution. What has evolved is what you get. Simpson, who came from a fundamentalist Presbyterian family, was

by nature always an intensely religious man. But his faith in an existent deity was non-existent (in middle life he worshipped with the Unitarians), and he certainly thought there could be no divine or similar support for moral belief.

At the level of normative ethics — "What should I do ?" — whereas some evolutionists (Julian Huxley, the grandson of Thomas Henry Huxley) were in favour of large-scale public works and other state-funded projects, Simpson looked much more to the individual level. There were two major directives. First, there was the need to improve and promote knowledge — knowledge in itself, as a good.

The most essential material factor in the new evolution seems to be just this: knowledge, together, necessarily, with its spread and inheritance. As a first proposition of evolutionary ethics derived from specifically human evolution, it is submitted that promotion of knowledge is essentially both the acquisition of new truths or of closer approximations to truth (metaphorically the mutations of the new evolution) and also its spread by communication to others and by their acceptance and learning of it (metaphorically its heredity). This ethic of knowledge is not complete and independent. In itself knowledge is necessarily good, but it is effective only to the degree that it does spread in a population, and its results may then be turned by human choice and responsible action for either good or evil. (Simpson 1949, 311)

Then secondly we have personal responsibility, which leads to integrity and dignity.

Beyond its relationship to the ethic of knowledge, the fact of responsibility has still broader ethical bearings. The responsibility is basically personal and becomes social only as it is extended in society among the individuals composing the social unit. It is correlated with another human evolutionary characteristic, that of high individualization. From this relationship arises the ethical judgment that it is good, right, and moral to recognize the integrity and dignity of the individual and

to promote the realization or fulfilment of individual capacities. It is bad, wrong, and immoral to fail in such recognition or to impede such fulfilment. This ethic applies first of all to the individual himself and to the integration and development of his own personality. It extends farther to his social group and to all mankind. Negatively, it is wrong to develop one individual at the expense of any other. Positively, it is right to develop all in the greatest degree possible to each within the group as a whole. Individuals vary greatly in other capacities, but integrity and dignity are capable of equal development in all. (Simpson 1949, 315)

And so on and so forth. I hardly have to say that the valuing of responsibility and dignity and so forth was equally a function of the times and society within which Simpson lived. We are talking now of the years when the Cold War was settling right into its long winter, when Soviet science was suffering under influential charlatans like Lysenko, and when issues of dictatorship and totalitarianism were all-too-fresh in people's memories and present in much of the world of the day. From dignity and responsibility, Simpson launched straight into a condemnation of the oppressive regimes then flourishing, and he juxtaposed this with a cherishing — if not an uncritical cherishing — of the society within which he found himself: "Democracy is wrong in many of its current aspects and under some current definitions, but democracy is the only political ideology which can be made to embrace an ethically good society by the standards of ethics here maintained" (p. 321).

There is quite a bit more, but my point by now is surely clear. Even a hundred years after the Origin, even after natural selection had been promoted to the core of a solid, functioning, professional evolutionary biology, evolutionists — the very best evolutionists — were still using their theory as a Christianity substitute (or, in the case of some, as a Christianity enhancer).

THE 21ST CENTURY

Let us come down to the present, sum up, and

draw a conclusion. I argue strongly and strenuously that there is today a mature evolutionary biology — Darwin-based, empirical, predictive, explanatory. It has felt and benefited from the full blast of the molecular revolution in biology, and it looks forward into this new century with great accomplishments, with powerful tools, and with anticipation of solving major problems old and new. I mention simply as illustration the incredible advances over the past two decades in the understanding of development and of how this is now being integrated into the evolutionary picture (so-called "evo-devo"). This evolutionary biology is not, and not by any stretch of the imagination, a secular religion, and those who quote me as saying that it is (or pretend that I have not mentioned and stressed its existence and importance) do me and evolutionary biology a grave disfavor. But, given our history, you would expect more to the story, and indeed there is. I argue also that — in the tradition of Thomas Henry Huxley, Herbert Spencer, and G.G. Simpson, and in an important way going right back to Erasmus Darwin and the birth of evolutionism — there is another side that continues unabated today. And this side does use evolution as a secular religion.

Some who play this game are, like Simpson, great evolutionary biologists in their own right. One thinks here of the distinguished Harvard entomologist and sociobiologist Edward O. Wilson, who has made major advances in our understanding of social behaviour. He nevertheless is explicit in wanting to make more of his science than mere science. Consider for instance the use he makes of evolution in his Pulitzer Prize-winning On Human Nature:

> But make no mistake about the power of scientific materialism. It presents the human mind with an alternative mythology that until now has always, point for point in zones of conflict, defeated traditional religion. Its narrative form is the epic: the evolution of the universe

from the big bang of 15 years ago through the origin of the elements and celestial bodies to the beginnings of life on earth. The evolutionary epic is mythology in the sense that the laws it adduces here and now are believed but can never be definitively proved to form a cause-and-effect continuum from physics to the social sciences, from this world to all other worlds in the visible universe, and backward through time to the beginning of the universe. Every part of existence is considered to be obedient to physical laws requiring no external control. The scientist's devotion to parsimony in explanation excludes the divine spirit and other extraneous agents. Most importantly, we have come to the crucial stage in the history of biology when religion itself is subject to the explanations of the natural sciences. As I have tried to show, sociobiology can account for the very origin of mythology by the principle of natural selection acting on the genetically evolving material structure of the human brain.

If this interpretation is correct, the final decisive edge enjoyed by scientific naturalism will come from its capacity to explain traditional religion, its chief competition, as a wholly material phenomenon. Theology is not likely to survive as an independent intellectual discipline. (Wilson 1978, 192)

Like Spencer (a thinker whom Wilson admires greatly), over the years Wilson has offered all sorts of moral prescriptions, most particularly about the need to preserve biodiversity and to cherish the plants of the world, especially those vanishing from the Brazilian rainforests (where Wilson has spent much of his professional life). And it will not surprise the reader to find that progress is the force and reason behind everything: "the overall average across the history of life has moved from the simple and few to the more complex and numerous. During the past billion years, animals as a whole evolved upward in body size, feeding and defensive techniques, brain and behavioral complexity, social organization, and precision of environmental

control — in each case farther from the nonliving state than their simpler antecedents did" (Wilson 1992, 187). Hence: "Progress, then, is a property of the evolution of life as a whole by almost any conceivable intuitive standard, including the acquisition of goals and intentions in the behavior of animals." For Wilson, as for Spencer and Simpson, progress confers value and hence it is our obligation to promote (or at least not hinder) the evolutionary process.

Others who play this game — making evolution into a secular religion — devote most of their professional efforts to this and related ends. It is in itself no criticism of Richard Dawkins to say that (certainly now that Stephen Jay Gould has died) he is the most ardent and prolific voice urging that we see in evolution, not just an answer to life's history, but also to the very meaning of that history — or rather, the non-meaning of that history. Dawkins seizes on natural selection as the complete answer to those Christians who still have a hankering after the argument from design, the so-called teleological argument. He will have none of this:

Paley's argument is made with passionate sincerity and is informed by the best biological scholarship of his day, but it is wrong, gloriously and utterly wrong. The analogy between the telescope and the eye, between watch and living organism, is false. All appearances to the contrary, the only watchmaker in nature is the blind forces of physics, albeit deployed in a very special way. A true watchmaker has foresight: he designs his cogs and springs, and plans their interconnections, with a future purpose in his mind's eye. Natural selection, the blind, unconscious, automatic process which Darwin discovered, and which we now know is the explanation for the existence and apparently purposeful form of all life, has no purpose in mind. It has no mind and no mind's eye. It does not plan for the future. It has no vision, no foresight, no sight at all. If it can be said to play the role of watchmaker in nature, it is the blind

watchmaker. (Dawkins 1986, 5)

More than this, Dawkins feels that Darwinism with its stress on a struggle for existence so magnifies the problem of evil, that Christian belief is not simply redundant but outrightly false.

If Nature were kind, she would at least make the minor concession of anesthetizing caterpillars before they are eaten alive from within. But Nature is neither kind nor unkind. She is neither against suffering nor for it. Nature is not interested one way or the other in suffering, unless it affects the survival of DNA. It is easy to imagine a gene that, say, tranquilizes gazelles when they are about to suffer a killing bite. Would such a gene be favored by natural selection? Not unless the act of tranquilizing a gazelle improved that gene's chances of being propagated into future generations. It is hard to see why this should be so, and we may therefore guess that gazelles suffer horrible pain and fear when they are pursued to the death — as most of them eventually are. The total amount of suffering per year in the natural world us beyond all descent contemplation. During the minute it takes me to compose this sentence, thousands of animals are being eaten alive; others are running for their lives, whimpering with fear; others are being slowly devoured from within by rasping parasites; thousands of all kinds are dying of starvation, thirst and disease. It must be so. If there is ever a time of plenty, this very fact will automatically lead to an increase in population until the natural state of starvation and misery is restored.

Theologians worry away at the 'problem of evil" and a related "problem of suffering." On the day I originally wrote this paragraph, the British newspapers all carried a terrible story about a bus full of children from a Roman Catholic school that crashed for no obvious reason, with wholesale loss of life. Not for the first time, clerics were in paroxysms over the theological question that a writer on a London newspaper (The Sunday

Telegraph) framed this way: “How can you believe in a loving, all-powerful God who allows such a tragedy?” The article went on to quote one priest’s reply: “The simple answer is that we do not know why there should be a God who lets these awful things happen. But the horror of the crash, to a Christian, confirms the fact that we live in a world of real values: positive and negative. If the universe was just electrons, there would be no problem of evil or suffering.”

On the contrary, if the universe were just electrons and selfish genes, meaningless tragedies like the crashing of this bus are exactly what we should expect, along with equally meaningless good fortune. Such a universe would be neither evil nor good in intention. It would manifest no intentions of any kind. In a universe of blind physical forces and genetic replication, some people are going to get hurt, other people are going to get lucky, and you won’t find any rhyme or reason in it, nor any justice. The universe we observe has precisely the properties we should expect if there is, at bottom, no design, no purpose, no evil and no good, nothing but blind, pitiless indifference. As that unhappy poet A.E. Houseman put it:

For Nature, heartless, witless Nature
Will neither know nor care.

DNA neither knows nor cares. DNA just is. And we dance to its music. (Dawkins 1995, 131-133)

It will come as no surprise to the reader to learn that, like Wilson, Dawkins is ardent for progress, believing that it comes through biological “arms races,” where organisms compete against each other, forever developing adaptations of attack and defense. Like real-life arms races, these have led to ever-greater forms of reasoning — on-board computers (better known as “brains”). No prizes are offered for guessing what species has emerged as the overall winner.

I do not pretend to have more religious belief than either Wilson or Dawkins. Nevertheless, I have elsewhere opposed

the inferences of both Wilson and Dawkins. I do not want to argue for Christianity as such, but I do want to argue that evolution (Darwinism in particular) does not imply the demise of Christianity. But such a defense is not my intent here, and for the sake of argument I am now happy to agree that the conclusions of Wilson and Dawkins are well taken. My intent here is simply to draw your attention to the fact that the tradition of making evolution into something more than a science — into a secular religion, to be blunt — is far from dead. It thrives on both sides of the Atlantic (and I am sure elsewhere, even — or perhaps especially — in post-Communist Russia). Anyone who thinks Wilson, Dawkins, and many others are not offering an evolution-based, Christianity alternative should read the pertinent passages again.

And with my conclusion drawn, I will now allow myself a prescription. I do not want to stop Wilson or Dawkins or anyone else from doing what they do. Apart from anything else, as a historian and philosopher of science, I would be putting myself out of a job! And, too soon, people would be suggesting that I should not do what I do. But I do want to say to my fellow evolutionists, to my fellow Darwinians: Be aware of what you are doing, and do not pretend that you are doing straight science when you are not. Most particularly _ and here I speak particularly to those of us who live and work in America — do not mix up your science and religion when you are teaching. It is illegal and unwise. The Creationists are out there watching what you are doing, and if you are teaching religion (secular or otherwise) under the guise of science, they will soon find out. And then they will have a lever, either to teach Creationism in the schools or to ban evolution from the schools. Either of these disjuncts would be a tragedy.

REFERENCES

Bannister, R. 1979. Social Darwinism: Science and Myth in Anglo-American Social Thought. Philadelphia: Temple

University Press.
Bates, H W. [1862]1977. “Contributions to an insect fauna of the Amazon Valley.” In Collected Papers of Charles Darwin. Edited by P.H. Barrett, 87-92. Chicago: Chicago University Press.
Chambers, R. 1844. Vestiges of the Natural History of Creation. London: Churchill.
Coleman, William. 1964. Georges Cuvier Zoologist: A Study in the History of Evolutionary Theory. Cambridge, Mass.: Harvard University Press.
Cuvier, G. [1813]1822. Theory of the Earth. 4th ed. Edited by Robert Jameson. Edinburgh: William Blackwood.——. 1817. “Le r_gne animal distribu_ d’apr_s son organisation, pour servir de base _ l’histoire naturelle des animaux et d’introduction _ l’anatomie compar_e.” Paris.
Darwin, C. 1859. On the Origin of Species. London: John Murray.——. 1862. On the Various Contrivances by which British and Foreign Orchids are Fertilized by Insects, and On the Good Effects of Intercrossing. London: John Murray.——. 1871. The Descent of Man. London: John Murray.———. 1985. The Correspondence of Charles Darwin. Cambridge: Cambridge University Press.
Darwin, E. 1801. Zoonomia; or, The Laws of Organic Life. 3rd ed. London: J. Johnson.——. 1803. The Temple of Nature. London: J. Johnson.
Dawkins, R. 1986. The Blind Watchmaker. New York, N.Y.: Norton.———. 1995. A River Out of Eden. New York, N.Y.: Basic Books.
Dennett, D.C. 1995. Darwin’s Dangerous Idea. New York: Simon and Schuster.
Dobzhansky, T. 1937. Genetics and the Origin of Species. New York: Columbia University Press.
Fisher, R.A. 1930. The Genetical Theory of Natural Selection. Oxford: Oxford University Press.
Ford, E.B. 1964. Ecological Genetics. London: Methuen.
Huxley, J.S. 1927. Religion Without Revelation. London: Ernest Benn.
King-Hele, D., editor. 1981. The Letters

of Erasmus Darwin. Cambridge: Cambridge University Press.

Kuhn, T. 1962. The Structure of Scientific Revolutions. Chicago: University of Chicago Press.

Malthus, T.R. 1826. An Essay on the Principle of Population (Sixth Edition). London.

Mayr, E. 1942. Systematics and the Origin of Species. New York, N.Y.: Columbia University Press.

Paley, W. [1802]1819. Natural Theology (Collected Works: IV). London: Rivington.

Popper, K.R. 1974. "Darwinism as a metaphysical research programme." In The Philosophy of Karl Popper. Editor P A Schilpp, 133-43. Vol. 1. LaSalle, Ill.: Open Court.

Ruse, M., Editor. 1988. But is it Science? The Philosophical Question in the Creation/Evolution Controversy. Buffalo, N.Y.: Prometheus.———. 1996. Monad to Man: The Concept of Progress in Evolutionary Biology. Cambridge, Mass.: Harvard University Press.———. 1999a. The Darwinian Revolution: Science Red in Tooth and Claw. 2nd ed. Chicago: University of Chicago Press.———. 1999b. Mystery of Mysteries: Is Evolution a Social Construction? Cambridge, Mass.: Harvard University Press.———. 2000. The Evolution Wars: A Guide to the Controversies. Santa Barbara, California: ABC-CLIO.———. 2001. Can a Darwinian be a Christian? The Relationship between Science and Religion. Cambridge: Cambridge University Press.———. 2003. Darwin and Design: Science, Philosophy, Religion. Cambridge, Mass.: Harvard University Press.

Russett, C.E. 1976. Darwin in America: The Intellectual Response. 1865-1912. San Francisco: Freeman.

Simpson, G.G. 1944. Tempo and Mode in Evolution. New York, N.Y.: Columbia University Press.———. 1949. The Meaning of Evolution. New Haven, Conn.: Yale University Press.———. 1953. The Major Features of Evolution. New York, N.Y.: Columbia University Press.

Spencer, H. 1852. "The

development hypothesis." In Essays: Scientific, Political and Speculative. H Spencer, 377-83. London: Williams and Norgate.———. 1852. "A theory of population, deduced from the general law of animal fertility." Westminster Review 1: 468-501.———. 1857. "Progress: Its law and cause." Westminster Review LXVII: 244-67.

Stebbins, G.L. 1950. Variation and Evolution in Plants. New York, N.Y.: Columbia University Press.

Whewell, W. 1840. The Philosophy of the Inductive Sciences (2 vols). London: Parker.

Wilson, E.O. 1978. On Human Nature. Cambridge, Mass. Cambridge University Press.———. 1992. The Diversity of Life. Cambridge, Mass.: Harvard University Press.

Wright, S. [1931]1986. "Evolution in Mendelian populations." Genetics, 16:2 (1931). In Evolution: Selected Papers. Edited by W B Provine. Chicago: Chicago University Press. ———. [1932]1986. "The Roles of Mutation, Inbreeding, Crossbreeding and Selection in Evolution" (1932). In Evolution: Selected Papers. Edited by W.B Provine. Chicago: Chicago University Press.

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