

Young, R. M. (1971 a): Darwin's Metaphor. Does Nature Select? The Monist 55: 442-503.

Darwin's Metaphor: Nature's Place in Victorian Culture

by

Robert M. Young

CHAPTER IV

DARWIN'S METAPHOR: DOES NATURE SELECT?

I

It is not too great an exaggeration to claim that *On the Origin of Species* was, along with *Das Kapital*, one of the two most significant works in the intellectual history of the nineteenth century. As George Henry Lewes wrote in 1868, "No work of our time has been so general in its influence." However, the very generality of the influence of Darwin's work provides the chief problem for the intellectual historian. Most books and articles on the subject assert the influence but remain very imprecise about its nature. It is very difficult indeed to assess what it was about the Darwinian theory which was so influential and how its influence was felt. This problem in Victorian intellectual history intersects with a related one in the history of science. There has been a tendency on the part of historians of science to isolate Darwin in two related ways. The first is to single him out from the mainstream of nineteenth-century naturalism in Britain and allow "Darwinism" to stand duty for the wider movement of which it was in fact but a part. The second is the tendency to single out his evolutionary theory and to demarcate it sharply from those of his predecessors and contemporaries. According to this interpretation Darwin stood alone as a real, empirical scientist and provided the first genuinely scientific hypothesis for the process by which evolution might have occurred. The theories of the other main evolutionists -Erasmus Darwin, Lamarck, Chambers, Spencer, and Wallace - were more or less besmirched by ideological, anthropomorphic, or other "nonscientific" factors or by the uses to which they were put by their authors. Charles Darwin is thus made to stand out as

a figure of comparatively unalloyed scientific status and is treated in relative isolation from the social and intellectual context in which he worked and into which his theory was received.

Of course Darwin's theory was based on a more plausible scientific hypothesis than those of the other evolutionists, and he was much less interested in philosophical, theological, and social issues: he was primarily a naturalist. But when one tries to relate the accounts of historians of science to the problem of Darwin's place in intellectual history one finds a gap between the generality of his influence and the particularity of his theory. It is hoped that a very close look at the putatively most scientific aspect of Darwin's theory will help to shed light on his general influence. I shall concentrate on a very close analysis of the texts in an attempt to show that the fine texture of the scientific debate directly involves theological and philosophical issues. These were constitutive, not contextual. In approaching the problem in this way I hope to show that the scientific heart of the theory raised fundamental philosophical and theological issues and that an account of the ways in which the theory was misunderstood and the process by which Darwin partially abandoned it can help us to reach a clearer appreciation of its role in the wider debate. I shall give an account of the crucial role which the analogy between "artificial" and "natural" selection played in the development, exposition, and reception of Darwin's theory. I shall then argue that this analogy provides an opportunity to show the theological, philosophical, and scientific difficulties which he encountered in his own writings and in his correspondence.

II

It is well known that the Darwin-Wallace theory of evolution by means of natural selection had the effect of changing the tenor of the evolutionary debate from one of speculation and heated controversy to an atmosphere in which the controversialists were at last dealing with a scientific hypothesis which had to be taken seriously. Others had provided vague or implausible theories of how the process of evolution might occur, but Darwin and Wallace provided a genuine *mechanism*. Darwin put the issue very clearly in 1860 in a letter to Professor Baden Powell:

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No educated person, not even the most ignorant, could suppose that I meant to arrogate to myself the origination of the doctrine that species had not been independently created. The only novelty in my work is the attempt to explain *how* species became modified, & to a certain extent how the theory of descent explains certain large classes of facts; & in these respects I received no assistance from my predecessors.

Shortly thereafter and for a period of almost seventy years the fortunes of the mechanism of natural selection waned, but it was established in the 1930s as the basis of modern neo-

Darwinian theory. Since 1900 the basis of the mechanism has been progressively spelled out by the findings of geneticists and molecular biologists.

It is a commonplace that the debate surrounding the Darwinian theory was itself a watershed for related controversies in geology, psychology, physiology, social theory, politics, anthropology, sociology, historiography, biblical exegesis, theology, and scientific methodology. This provides the basis for the claims that Darwin's work ranks with that of Vesalius and Harvey in the biomedical and human sciences and that its significance is of a comparable order to the metaphysical, methodological, and scientific revolution which is associated with the tradition from Tycho and Copernicus and includes Kepler, Galileo, Descartes, and Newton. Various aspects of this wider debate have been studied in detail, but most of those who have attempted to assess the impact of Darwin on this or that discipline have given suggestive but rather imprecise accounts. If one sacrifices scope in the hope of gaining precision, it may turn out that the study of the vicissitudes of a phrase - natural selection - can lead from the most internalist, scientific aspect of the theory to general philosophical, theological, and social issues.

The argument falls into several distinct sections. First, an attempt will be made to reconstruct the problem which Darwin faced and the pitfalls which he set out to avoid. Next, the path by which he tells us he solved it will be shown, along with the strategy which this yielded for his attempts to convince others that he had done so. Thirdly, it will be shown that his precise solution turned out to be very fragile: this involves an account of the way in which he employed the concept of natural selection and the difficulties into which this got him at the hands of friends, foes, and would-be interpreters, until a stage was reached where

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Darwin's theory became hybridized and partially transmuted into a mongrel breed. Finally, it will be suggested that *On the Origin of Species*, like the works of Lyell, Chambers, Powell, and Spencer before it, was really more effective in eliciting faith in the philosophical principle of the uniformity of nature than in providing an acceptable mechanism for evolutionary change.

III

The main outline of the development of Darwin's theory is so familiar that it may help to be reminded of the conceptual issues which he faced. On the voyage of the *Beagle* he had been struck by three classes of phenomena: the geographical distribution of living species along the South American continent, the geological relations of present to past species there, and the curious fact that different but very closely allied species coexisted on islands in the Galapagos group - islands which were identical in climate but slightly separated in space from one another and from the mainland. It is worth noticing that the length of

Darwin's voyage provided the kind of perspective in space and time which was conducive to asking large questions.

There is some evidence that Darwin had doubts about the stability of species as early as 1832, but this is an unremarkable claim, since he had knowledge of the theories of his grandfather and of Lamarck and since he had carried the first volume of Charles Lyell's *Principles of Geology* on board the *Beagle*, and volume two (containing a careful exposition and analysis of Lamarck's theory) reached him in Montevideo. It is much more significant that when he returned after five years from his 37,000-mile voyage, Darwin began a series of notebooks in which he patiently accumulated all sorts of facts which could possibly have any bearing on the question of the origin of species, a problem which Sir John Herschel had dubbed the "mystery of mysteries." These notebooks provide such a rich and detailed record of his reflections that Howard Gruber has attempted to reconstruct the process of discovery which Darwin underwent, while a number of other scholars continue to mine its strata and veins, sifting for further understanding of Darwin's thought processes. Gruber points out that many times before the crucial experience of reading Malthus, Darwin refers to

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"the theory" and "my theory," but the meaning of these phrases is often obscure and changes from day to day.

Darwin's *strategy* for unraveling the problem centered on efforts to demonstrate that the species barrier was not, as had been traditionally thought, absolute. He did this by means of a close study of *domesticated* productions in an attempt to show that there was no practical limit to the changes which breeders could bring about over successive generations, that, in short, species were only well-marked varieties. This inquiry was ostensibly secondary to his main task - that of explaining how new species could come about by natural means. He tells us, however, that these studies provided the main path to the discovery of the theory and to its most effective exposition.

There were very powerful constraints on the kinds of theories for explaining the origin of species which the scientific community would be likely to entertain at all seriously. Darwin's intellectual mentor, Charles Lyell, had provided both the greatest helps and the greatest hindrances to any attempt to provide a satisfactory theory. He had insisted that only causes now in operation and in their present intensities - could be used to explain the history of the earth and the history of life. When these stringent criteria were applied to the question of the mutability of species, Lyell's judicious exposition and analysis of the evidence led to the conclusion that there was no evidence that present causes were producing modifications which, given sufficient time, could accumulate *directionally* so as to produce new species. Rather, Lyell supported Cuvier's orthodox conclusion that there was a definite limit to variations around a mean. It can be argued that Lyell's choice of the

relevant unit of time and his criterion of significant change (a new sense or a new organ) were niggardly in the light of his own geological time scale, but it should be remembered that reference to an extended present back to mummified Egyptian animals conformed to his main methodological criterion of considering only causes now in operation as the basis for analogies for making inferences about the past.

But this was not the main problem. Rather, it was that there seemed no way of providing unlimited directionality to cumulative change within a naturalist scientific metaphysic. By judicious mingling of metaphysical, methodological, and scientific versions of the principle of the uniformity of nature, Lyell had made a

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powerful case against divine, catastrophic, interventions in the course of the history of the earth. He had also provided a naturalistic account of the struggle for existence (a phrase which he employed) and the resulting *extinction* of species. But when Lyell turned to the question of the origin of new species, the *Principles of Geology* was nearly silent, and Lyell's own remarks on the subject in volume two and in his correspondence with Herschel are certainly confusing and probably confused. Indeed, he remained unable to see his way clearly to a theory of evolution for nearly forty years, and when he did accept Darwin's theory in 1868, it was with crucial reservations.

Darwin wrote in 1844,

I always feel as if my books came half out of Lyell's brain, and that I never acknowledge this sufficiently; nor do I know how I can without saying so in so many words - for I have always thought that the great merit of the *Principles* was that it altered the whole tone of one's mind and therefore, that when seeing a thing never seen by Lyell, one yet saw it partially through his eyes - it would have been in some respects better if I had done this less . . .

At one level, then - that of the principle of explanation by small changes in terms of the uniformity of nature - Lyell was the main source of Darwin's assumptions. But given that, he provided nothing but difficulties for Darwin. Lyell had made it clear that a number of proposed solutions to the problem of the origin of species were inadequate. The Lamarckian idea of an inherent progressive tendency in living nature was unacceptable. The secondary Lamarckian factor of modifications produced through striving, which were adapted to ends and were inherited, was considered to be volitional or quasi-volitional and was also unacceptable. These two aspects of Lamarck's theory seemed to partake of Lyell's real *bête noire*. A preordained or anthropomorphic mechanism, he feared, placed one on a slippery slope leading to divine intervention. Although Lyell seems at times to argue for piecemeal "creation" of new species to replace extinct ones, he was certainly opposed to what he took to be the reigning theory of wholesale geological catastrophes

and biological extinctions followed by a new geological era and a new complement of species, divinely created.

Consequently, Darwin was faced with the seemingly impossible

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problem of providing *directionality* without *progression*. It has been argued, notably by Professor Hooykaas, that the only source from which Darwin could draw directionality was from Lyell's *bête noire*, catastrophist geology. I think that it can be shown that Darwin saw the problem in sufficiently Lyellian terms for this path not to be open to him. Even the least interventionist versions of catastrophism seemed to Lyell and Darwin to undermine the very foundations of science. Although Lyell's theory of geological equilibrium was exceedingly restrictive and often led him to take a ridiculously defensive stance and although there are verbal similarities between moderate believers in geological directionality and Darwin's views, my reading of the debate in the crucial period between 1830 and 1842 (when Darwin first wrote out his theory) has convinced me that any available analogy between geological and biological directionality was metaphysically unacceptable to Darwin. In any case, my argument does not depend on this reading of the evidence. The plain fact is that Darwin simply did not see the problem in these terms. He took a different path - one which provided him with what appeared to be a completely naturalistic mechanism. My point is that he was so committed to Lyell's general philosophy of nature that he was unsympathetic to any alternative basis for geology as the source for an analogy which would solve his biological problem.

Darwin's approach lay almost wholly within biology. For him the crucial analogy lay between the unlimited changes which could be produced by breeders of domesticated varieties on the one hand and a similar process occurring in nature on the other. The argument which enabled Darwin to make this analogy was drawn from Malthus' *Essay on the Principle of Population*. Since I have already considered the role of Malthus' theory in Darwin's thinking, I will sketch only the main conclusions. Darwin's notebooks, his early drafts of the theory, his correspondence, his published works, and his own retrospective accounts make a strong case for the conclusion that several crucial warrants were provided by Darwin's reading of Malthus' *Essay* for pleasure in late 1838. Malthus' law of population of human society legitimized the idea of a *law* of struggle throughout living nature, impressed Darwin with the intensity of the struggle, and provided a convenient mechanism or a *natural* analogue to the changes which he was studying in the selection of domesticated varieties. Population *pressure* in the face

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of scarce resources allowed Darwin to slide from the directional intentions of breeders to unlimited directional change in nature, leading eventually to a new species. The reading of Malthus produced a real flash of insight for Darwin (just as recalling Malthus' theory was later to do for Wallace), and after the excited passages in the notebooks for late September and early October 1838, the phrases "the theory" and "my theory" have an increasingly precise meaning.

In 1844, six years after conceiving the mechanism of natural selection and two years after writing out a full sketch of his theory, Darwin conveyed his sense of the significance of his discovery to his friend, J. D. Hooker.

I have read heaps of agricultural and horticultural books, and have never ceased collecting facts. At least gleams of light have come, and I am almost convinced (quite contrary to the opinion I started with) that species are not (it is like confessing a murder) immutable. Heaven forbid me from Lamarck nonsense of a "tendency to progression," "adaptations from the slow willing of animals," &c! But the conclusions I am led to are not widely different from his; though the means of change are wholly so. I think I have found (here's presumption!) the simple way by which species become exquisitely adapted to various ends. You will now groan, and think to yourself, "on what a man have I been wasting my time and writing to." I should, five years ago, have thought so ...

In another letter to Hooker, written in the same year, Darwin reviews the mechanisms which had been proposed by others and concludes, "I believe all these absurd views arise from no one having, as far as I know, approached the subject on the side of variation under domestication, and having studied all that is known about domestication." Fourteen years later, he summarized the crucial steps in his thought in a letter he wrote to Wallace, after Wallace had independently discovered the same mechanism:

You are right, that I came to the conclusion that selection was the principle of change from the study of domesticated productions; and then, reading Malthus, I saw at once how to apply this principle. Geographical distribution and geological relations of extinct to recent inhabitants of South America first led me to the subject: especially the case of the Galapagos Islands.

In the frantic week in 1858, after receiving the paper in which Wallace's terms stood as the chapter headings in Darwin's nearly

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completed (but still secret) great work, *Natural Selection*, Darwin wrote to Lyell that he and Wallace differed "only, [in] that I was led to my views from what artificial selection has done for domestic." In the introduction to the *Origin*, Darwin wrote,

At the commencement of my observations it seemed to me probable that a careful study of domesticated animals and of cultivated plants would offer the best chance of making out this obscure problem. Nor have I been disappointed; in this and in all other perplexing cases I have invariably found that our knowledge, imperfect though it be, of variation under domestication, afforded the best and safest clue. I may venture to express my conviction of the high value of such studies, although they have been very commonly neglected by naturalists.

The path by which Darwin says he arrived at the mechanism of natural selection was also the one which he chose to follow in setting out his argument. The first version was a pencil sketch written in 1842. The section indicating the course of the argument begins with the heading, "On variation under domestication, and on the principles of selection." This is followed by "On variation in a state of nature and on the natural means of selection." Having established that there are countless small variations which can be selected by breeders for man's purposes and which then breed true, he continues, "Let us see how far [the] above principles of variation apply to wild animals." Having satisfied himself that they do, he makes the analogy which will preoccupy us for the rest of this argument. It should be seen in two ways. The first and obvious one is that he is moving from the *artificial* selection used by breeders to a *natural* mechanism. However, I want to draw attention to another feature of the analogy. In moving from artificial to natural, Darwin retains the anthropomorphic conception of *selection*, with all its voluntarist overtones. Thus the analogy is not merely a reflection of the process of discovery. The terms in which it is expressed had important consequences for the nature and the reception of the theory.

In the sketch of 1842, Darwin writes as follows:

But if every part of a plant or animal was to vary ... and if a being infinitely more sagacious than man (not an omniscient creator) during thousands and thousands of years were to select all the variations which tended towards certain ends ([or were to produce causes which tended to the same end]), for instance, if he foresaw a canine animal would be

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better off, owing to the country producing more hares, if he were longer legged and keener sight - greyhound produced.... Who, seeing how plants vary in garden, what blind foolish man has done in a few years, will deny an all-seeing being in thousands of years could effect (if the Creator chose to do so), either by his own direct foresight or by intermediate means - which will represent the creator of this universe.

Darwin then produces the concept of natural selection and supports it with Malthusian arguments - "the pressure is always ready" - and refers to natural selection as "rigid and scrutinizing." In the summary of this section, he says, "I conclude it is impossible to say we know the limit of variation. And therefore with the [adapting] selecting power of nature,

infinitely wise compared to those of man, I conclude that it is impossible to say we know the limit of races, which would be true to their kind . . ." In the conclusion of the sketch, Darwin couples his anthropomorphic language with his more fundamental commitment to the uniformity of nature (the curious juxtaposition which provides the subject of much of what follows in this essay):

We must look at every complicated mechanism and instinct, as the summary of a long history of useful contrivances, much like a work of art.... It accords with what we know of the law impressed on matter

by the Creator, that the creation and extinction of forms, like the birth and death of individuals should be the effect of secondary [laws] means. It is derogatory that the Creator of countless systems of worlds should have created each of the myriads of creeping parasites and [slimy] worms which have swarmed each day of life on land and water on [this] one globe.

In the expanded *Essay* of 1844, the relevant chapter is written in the same terms and entitled "On the Variation of Organic Beings in a Wild State; On the Natural Means of Selection; and On the Comparison of Domestic Races and True Species."

IV

The year 1844 was also the year in which Robert Chambers' *Vestiges of the Natural History of Creation* appeared. This was a work which set aside all the scientists' reservations and embraced the histories of the earth, life, and man within the uniform course of natural laws. Chambers presented a great deal of geological and

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biological evidence in a way which allowed his critics to dismiss the argument because of his hopeless scientific blunders. The fate of Chambers' attempts to support his theory by appealing to the fossil record convinced Darwin *not* to present his argument that way around, and led him to tuck away the geological issues in Part II of *On the Origin of Species*, following the less deliberate procedure of his early drafts.

Chambers also suffered from a very explicit version of confusion about the causes of transmutation. His real concern was with the principle of the uniformity of nature, and the different and loosely conceived "mechanisms" which he mentions in the course of the book are neither mutually consistent nor developed in detail. Just as Lyell had done with more precision with respect to the history of the earth in the *Principles of Geology*, Chambers seemed to think that some sort of naturalistic theory had to follow from the metaphysical principle of the uniformity of nature:

... it being admitted that the system of the Universe is one under the dominion of natural law (*natural law* being guardedly defined as a mere term for that order which the Deity observes in his operations), it follows that the introduction of species into the world must have been brought about in the manner of natural law also. The proposition is simply a syllogism: what is granted of the whole must be granted of a part.

In the first edition of *Vestiges*, it all seemed very simple to Chambers:

Thus the whole is complete on one principle. The masses of space are formed by law; law makes them in due time theatres of existence for plants and animals; sensation, disposition, intellect, are all in like manner developed and sustained in action by law. It is most interesting to observe into how small a field the whole of the mysteries of nature thus ultimately resolve themselves. The inorganic has one final comprehensive law, GRAVITATION. The organic, the other great department of mundane things, rests in like manner on one law, and that is, - DEVELOPMENT. Nor may even these be after all twain, but only branches of one still more comprehensive law, the expression of that Unity which man's wit can scarcely separate from Deity itself.

The author of *Vestiges* (whose name was not made public until 1881) was roundly and vehemently criticized by Herschel, Huxley, and many others for confusing the general conception of natural law with the precise cause or causes of evolutionary change.

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In contrasting Chambers' hypothesis with Darwin's specific mechanism, G. H. Lewes wrote in 1868:

The hypothesis put forth in the "*Vestiges*," though it had the merit of connecting the organic evolution with the cosmical evolution, uniting the hypotheses of Lamarck and Meckel with the nebular hypothesis of Kant and Laplace, laboured under the great disadvantage of reposing on two principles which only a metaphysician could accept *as verae causae*.

Chambers became clearer about his real aims as a result of these and other criticisms, wrote a less naive sequel entitled *Explanations*, and added a series of "Proofs, Illustrations, Authorities, Etc." to later editions of *Vestiges*, where he wrote,

Now the real position of the development hypothesis is this. It being granted that the world is one of law and order, and consequently that organic beings must have originated in accordance with some law, it becomes us as reasonable beings to look about through nature, in order to see if there be any such law still in operation, or even any traces of its operation in a past age.....

I have done nothing more than suggest the *probability* of some such method having been followed by the Creator, after showing facts in the history of nature which give the idea some countenance.

Professor Baden Powell spelled out the underlying theme in the works of both Lyell and Chambers in his 1855 essay "The Philosophy of Creation," and while these writings had the effect of sharpening the question of the precise cause or mechanism of evolution, they also help to make one of my main points, viz., that the inadequacies of Lyell's uniformitarianism and Chambers' theory of development should be set alongside those of Darwin's mechanism of natural selection. All of these theorists confused metaphysical, methodological, and scientific levels of analysis, but as they retreated from specific scientific explanations, there remained the influence of their work as contributions to the mainstream of nineteenth-century naturalism, leading to a growing acceptance of the philosophical principle of the uniformity of nature, a principle which could be harmlessly identified with the intentions and the nature of the Deity, once arbitrary interventions had been banished from nature (including human nature). Darwin sharply contrasted his work with that of the author of *Vestiges*. On the other hand, he admired Powell's essay which defended it, while replying tartly to a letter from Powell claiming priority for

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his discoveries, since (in the passage quoted above) Darwin saw himself as having shown once and for all, *how* species became modified. Once we see the curious fate of Darwin's mechanism, it would seem that Darwin's work was not as unlike that of his predecessors as has often been supposed.

The strategy of the remainder of my argument, therefore, will be to assimilate Darwin's privileged status as a scientist to that of contemporaries whose scientific reputations are less secure. But before doing so it may be useful to give examples of the sorts of views to which I believe Darwin's position is closer than many students of the debate have considered to be the case.

Herbert Spencer is second only to Chambers in the degree to which historians have denigrated his "scientific" status. He wrote as follows of his own views on the relationship between the uniformity of nature and his belief in evolution:

Doubtless my intellectual leaning towards belief in natural causation everywhere operating, and my consequent tendency to disbelieve alleged miracles, had much to do with my gradual relinquishment of the current creed and its associated story of creation - a relinquishment which went on insensibly during early manhood. Doubtless, too, a belief in evolution at large was then latent; since, little as the fact is recognized, anyone who, abandoning the supernaturalism of theology, accepts in full the naturalism of science, tacitly asserts that all things as they now exist have been evolved. The doctrine of the

universality of natural causation, has for its inevitable corollary the doctrine that the Universe and all things in it have reached their present forms through successive stages physically necessitated.

Lyell had confined his arguments to the history of the earth, and the writings of Spencer and Chambers (both of whom expressed heavy debts to Lyell) simply pointed out that he could not stop there. In the key theoretical chapter of volume one of his *Principles*, Lyell said,

We have considered, in the preceding chapters, many of the most popular grounds of opposition to the doctrine, that all former changes of the organic and inorganic creation are referrible to one uninterrupted succession of physical events, governed by the laws now in operation.

As the principles of the science [of geology] must always remain unsettled so long as no fixed opinions are entertained on this fundamental question, we shall proceed to examine other objections which have been urged against the assumption of uniformity in the order of nature.

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Powell takes up this point and applies it to the principles of *all* science:

No inductive inquirer can bring himself to believe in the existence of any *real hiatus* in the continuity of physical laws in the past eras more than in the existing order of things; or to imagine that changes, however seemingly abrupt, can have been brought about except by the gradual agency of some regular causes. On this principle the whole superstructure of rational geology entirely reposes; to deny them in any instance would be to endanger all science.

In extending this position from the history of the earth to the history of life (by drawing on the basic assumptions of *Vestiges*), Powell points out that the argument is "independent of the supposed *mode* of introduction of new species."

These remarks were made in 1855, three years before Darwin's theory became public. As we turn to his correspondence and the published debate on his theory, it will be interesting to see how Darwin's supposedly purely scientific hypothesis finds its way back to the fundamental metaphysical position, partly *because* of its anthropomorphic overtones.

V

The joint Darwin-Wallace paper read to the Linnean Society in July 1858 shows that Darwin's anthropomorphic way of writing about natural selection had become

characteristic. His contribution contains a letter he had written to the American botanist, Asa Gray, in 1857, which was included in order to establish Darwin's priority over Wallace. Its three sections move from the principle of selection by man to the figurative "wiser being" to the claim that "I think it can be shown that there is such an unerring power at work in *Natural Selection* (the title of my book), which selects exclusively for the good of each organic being." He adds, "Multiform difficulties will occur to every one, with respect to this theory. Many can, I think, be satisfactorily answered. *Natura non facit saltum* answers some of the most obvious. The slowness of change, and only a few individuals undergoing change at any one time, answers others. The extreme imperfection of our geological records answers others." In a postscript to the original letter,

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Darwin says, "This little abstract touches only the accumulative powers of natural selection, which I look at as by far the most important element in the production of new forms."

Anthropomorphic, voluntarist descriptions of natural selection occur throughout *On the Origin of Species*, the abstract of the larger work, which appeared at the end of 1859. It will help to sharpen our sense of how remarkable this is if it is recalled that the rules of scientific explanation which were developed in the seventeenth century banished purposes, intentions, and anthropomorphic had expressions from scientific explanations. Biologists, however, had never been very good at confining their explanations to matter, motion, and number. They had persisted in employing powers and faculties and had moved on to slightly less septic categories such as biological properties (e.g., irritability, contractility, sensibility) in spite of the official paradigm. But even by the loose standards of biological explanation, it is surprising to find such rank anthropomorphism at the heart of the most celebrated unifying theory in biology.

The practice first appears in the subtitle of the book: *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. Putting the matter briefly, one would be hard put to find the following terms in a physics text adhering to the official paradigm of scientific explanation in terms of matter, motion, and number (or, latterly, energy and force): selection, preservation, favored, struggle (or, for that matter, the concept of life itself).

In the body of Darwin's text there are numerous expressions of the analogy. The second paragraph of the chapter entitled "The Struggle for Existence" says,

We have seen that man by selection can certainly produce great results, and can adapt organic beings to his own uses through the accumulation of slight but useful variations, given to him by the hand of Nature. But Natural Selection, as we shall hereafter see, is a

power incessantly ready for action, and is as immeasurably superior to man's feeble efforts, as the works of Nature are to those of Art.

In the second sentence of the chapter entitled "Natural Selection," Darwin writes, "Can the principle of selection, which we have seen is so potent in the hands of man, apply in nature? I think that

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we shall see that it can act most effectually." He goes on to say, "As man can produce and certainly has produced a great result by his methodical and unconscious means of selection, what may not nature effect?"

After the analogy has been made, natural selection is itself described in surprisingly anthropomorphic terms:

It may be said that natural selection is daily and hourly scrutinizing, throughout the world, every variation, even the slightest; rejecting that which is bad, preserving and adding up all that is good; silently and insensibly working, whenever and wherever opportunity offers, at the improvement of each organic being in relation to its organic and inorganic conditions of life.

Throughout the book natural selection is described as "acting," and "nature's power of selection" is a recurring phrase. We find Darwin repeatedly writing in florid terms about the "visual powers" and "skills" of this putatively natural mechanism: "there is a power always intently watching"; "natural selection will pick out with unerring skill each improvement."

In his "Recapitulation and Conclusion," Darwin reverts to the analogy:

There is no obvious reason why the principles which have acted so efficiently under domestication should not have acted under nature. . . .

If then we have under nature variability and a powerful agent always ready to act and select, why should we doubt the variations in any way useful to beings, under their excessively complex relations of life, would be preserved, accumulated, and inherited? Why, if man can by patience select variations most useful to himself, should nature fail in selecting variations useful, under changing conditions of life, to her living products? What limit can be put to this power, acting during long ages and rigidly scrutinizing the whole constitution, structure, and habits of each creature, - favouring the good and rejecting the bad? I can see no limit to this power, in slowly and beautifully adapting each form to the most complex relations of life. The theory of natural selection, even if we looked no further than this, seems to me to be in itself probable.

Once again he links his anthropomorphic description of natural selection with the principle of the uniformity of nature:

As natural selection acts solely by accumulating slight, successive, favourable variations, it can produce no great or sudden modification; it can act only by very short and slow steps. Hence the canon of "Natura

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non facit saltum," which every fresh addition to our knowledge tends to make more strictly correct, is on this theory simply intelligible. We can plainly see why nature is prodigal in variety, though niggard in innovation. But why this should be a law of nature if each species has been independently created, no man can explain.

Now of course it can be argued that all this is making heavy weather of something which is rather obvious and innocent. Indeed, Darwin says at one point in the *Origin* that he called the principle "natural selection" "for the sake of brevity." Again, when his publisher objected to the term, Darwin apologized for its being obscure and wrote to Lyell, "Why I like the term is that it is constantly used in all works on breeding, and I am surprised that it is not familiar to Murray; but I have so long studied such works that I have ceased to be a competent 'udge." Breeders used the term to refer to any agency operating outside the sphere of man's control; it was merely a convenient way of contrasting unknown sources of change with deliberate ones. It is certainly arguable that the origins of the phrase were innocent enough, but it is also clear that its overtones and the ways in which Darwin wrote about it both reflected and raised grave difficulties. After some of these began to emerge, Darwin wrote to Lyell, "Talking of 'natural selection;' if I had to commence *de novo*, I would have used 'natural preservation.' For I find that men like Harvey of Dublin cannot understand me, though he has read the book twice." (It is worth noting in passing that although the term "preservation" eliminates some of the voluntarist overtones from the interpretation of the sources of variation, it still conveys the impression that active processes with voluntary overtones are operative in the accumulation of modifications.)

In later editions of the *Origin* Darwin tried to escape the implication that selection was involved in both the occurrence and the preservation of variations. Once again, however, he used the analogy to artificial selection. "When man is the selecting agent," he wrote, "we clearly see that the two elements of change are distinct; variability is in some manner excited, but it is the will of man which accumulates the variations in certain directions; and it is this latter agency which answers to the survival of the fittest under nature." Even so, this left the selecting process voluntaristic, and in the third edition we find Darwin adding a very significant passage aimed at extricating himself from the difficulties raised by the

phrase. The passage contains Darwin's reply to the problems with which the rest of this essay will be concerned.

Several writers have misapprehended or objected to the term Natural Selection. Some have even imagined that natural selection induces variability, whereas it implies only the preservation of such variations as arise and are beneficial to the being under its conditions of life. No one objects to agriculturists speaking of the potent effects of man's selection; and in this case the individual differences given by nature, which man for some object selects, must of necessity first occur. Others have objected that the term selection implies conscious choice in the animals which become modified; and it has even been urged that, as plants have no volition, natural selection is not applicable to them! In the literal sense of the word, no doubt natural selection is a false term; but who ever objected to chemists speaking of the elective affinities of the various elements? - and yet an acid cannot strictly be said to elect the base with which it in preference combines. It has been said that I speak of natural selection as an active power or Deity; but who objects to an author speaking of the attraction of gravity as ruling the movements of the planets? Every one knows what is meant and is implied by such metaphorical expressions; and they are almost necessary for brevity. So again it is difficult to avoid personifying the word Nature; but I mean by Nature, only the aggregate action and product of many natural laws, and by laws the sequence of events as ascertained by us. With a little familiarity such superficial objections will be forgotten.

Darwin has here raised at least five separate issues. The first pertains to the causes of variability and makes it clear that he is not referring to these but to the preservation of those variations which happen to be advantageous. His second point is less significant and merely dissociates his views from those who so misunderstood his theory as to think that it was a revival of the Lamarckian factor of striving. Darwin then makes an important claim for biology that concepts like his are no more or less mysterious than the physicochemical concept of "affinity." He had earlier written to Lyell to say that he felt in good company, since Leibniz had objected to the law of gravity and claimed that it was opposed to Natural Religion because Newton could not show what gravity is. Fourthly, Darwin again appeals to the physical sciences to say that if gravity can be said in some sense to rule the movements of the planets, why do people suspect that natural selection is an active power or deity? This point is related to very deep issues in

nineteenth-century debates on the philosophy of nature which deserve further study but which require a very different approach from that being taken in this essay. Finally, Darwin insists that his phrase is merely a metaphorical expression, which is "almost necessary for brevity." It is difficult to avoid personifying natural selection and nature itself, but these

terms really refer only to the aggregate action and product of many natural laws. Nor are laws mysterious: they, in turn, refer only to regular sequences of events. This is the nominalist position which was expounded in the nineteenth century by phenomenalists and their partial allies among the Positivists. The point of view is at the heart of the British empiricist tradition, and although Darwin was very diffident about his grasp of philosophy, he was certain that his position was allied to this one. Unfortunately, however, his hope that "With a little familiarity such superficial objections will be forgotten" turned out to be false for very good contemporary philosophical, theological, and scientific reasons.

How had Darwin exposed himself to so much misunderstanding, and what were the objections against which he was defending himself and had to go on doing until the end of his life? It seems to me that there are three related reasons for Darwin's writing as he did about natural selection and that these led almost inevitably to the difficulties which he encountered. The first is obvious. We have seen that it was an accident, a result of the course of his inquiries, that he made the analogy that he did in the way that he did. However, his decision to spell out his argument in the same terms is related to the intellectual atmosphere of his education and the prevailing theory of the origin of adaptations. The second reason, is, therefore, the strong influence of the tradition of natural theology on the assumptions of science. In freeing himself from belief in the static, designed adaptations which he had found so appealing in his reading of William Paley as an undergraduate, Darwin retained the rhetoric of deliberate, piecemeal design. At one level the distance between the approach of Paley and that of Darwin is much less than it appears to be. The changing context of the concept of adaptation from that of static design in Paley's *Natural Theology* and in the *Bridgewater Treatises* to that of dynamic piecemeal natural change deserves a separate study. For the present it is worth pointing out that Darwin's theory was no less bound by the principle of utility than was that of Paley. In *The Descent of*

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Man Darwin admitted the extent to which this way of looking at nature had remained with him: "I was not able to annul the influence of my former belief, then almost universal, that each species had been purposely created; and this led to my tacit assumption that every detail of structure, excepting rudiments was of some special, though unrecognized, service." Like Paley, Darwin began with artifice and with familiar examples in order to win over his audience. Like Paley, he employed repeated examples and rhetorical questions in order to bring his reader to make the leap of faith which his theory required. The same cast of mind carried over to Darwin's writing about natural selection, and others were quick to point this out.

The third reason for Darwin's writing about natural selection as he did was more straightforwardly scientific. In proposing the theory of evolution by means of the mechanism of natural selection he was not really supplying a mechanism at all. Rather, he

was providing an abstract *account* at a general level of how favorable variations might be preserved. He *had* to keep his account at a certain level of abstraction since, as he confessed, he could specify neither the laws of variation nor the precise means by which variations were preserved. The acceptability of his account depended on its plausibility and its ability to explain in very general terms the *sort* of process which was involved. He could neither show evolution at work nor provide a complete example of the stages by which it had worked. The former process was too slow while the record of its having occurred was too fragmentary. Darwin's task was to explain *away* the *lack* of evidence while repeatedly stressing the greater plausibility of his theory over that of special creation. Whenever he was really in trouble he adopted the same tactic as Lyell, Chambers, and Powell had done - he appealed to the very principle which was at issue, the uniformity of nature. By creatively confusing the metaphysical regulative principle of science with particular empirical issues, his argument *gained* plausibility from its circularity. John Tyndall put the point in the best possible light in his highly controversial "Belfast Address" in 1874: "The strength of the doctrine of Evolution consists, not in an experimental demonstration (for the subject is hardly accessible to this mode of proof), but in its general harmony with scientific thought."

Therefore, the third explanation of Darwin's way of writing

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about natural selection was that it allowed him to present his account almost as though it was a real mechanism. I mean to imply no disingenuousness on his part. Indeed, when it was pointed out that even at this level of abstraction his theory was insufficient, Darwin went into a dignified retreat and was left with the very sort of mixed bag of factors which he had rejected at the outset of his studies. He was left with only one unalloyed claim to plausibility: the uniformity of nature.

In the remainder of this essay I shall sketch two classes of objections to Darwin's treatment of natural selection. There are worthwhile papers to be written on each of the figures whom I shall mention, and a detailed study of the whole debate remains to be done. However, the general picture can be discerned by allusions to the reactions of those who dwelt on the theological and philosophical objections to this theory and those (often the same people) who pointed out the scientific inadequacies of his account.

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From the outset there were signs that trouble lay ahead at the hands of outright opponents of evolution (e.g., Wilberforce), friendly foes (Sedgwick), and sympathetic critics (e.g., Lyell). In the most famous review of the *Origin*, Bishop Samuel Wilberforce deftly turned Darwin's own language against him.

Nor must we pass over unnoticed the transference of the argument from the domesticated to the untamed animals. Assuming that man as the selector can do much in a limited time, Mr. Darwin argues that Nature, a more powerful, a more continuous power, working over vastly extended ranges of time, can do more. But why should Nature, so uniform and persistent in all her operations, tend in this instance to change? Why should she become a selector of varieties?

The implication is that while nature must operate by uniform laws, God can intervene in the course of nature to produce new species. Of course, this sort of reaction was to be expected, and little purpose would be served by repeating the arguments of those who opposed Darwin's theory on relatively literalist, interventionist grounds. There is more to be learned from writers who held intermediate positions.

Moving to the other extreme, important reservations were expressed

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from the least likely quarter of all. In the first public statement of the theory - the joint Darwin-Wallace paper of 1858 - Darwin's coauthor wrote, "We see, then, that no inferences as to varieties in a state of nature can be deduced from the observation of those occurring among domestic animals. The two are so much opposed to each other in every circumstance of their existence, that what applies to the one is almost sure not to apply to the other." Many years later Wallace wrote, "It has always been considered a weakness in Darwin's work that he based his theory, primarily, on the evidence of variation in domesticated animals and cultivated plants." By 1866 the phrase was causing so much trouble that Wallace wrote a friendly letter in which he attempted to persuade Darwin to drop it altogether.

I have been so repeatedly struck by the utter inability of numbers of intelligent persons to see clearly, or at all, the self-acting and necessary effects of Natural Selection, that I am led to conclude that the term itself, and your mode of illustrating it, however clear and beautiful to many of us, are yet not the best adapted to impress it on the general naturalist public.

He gives two examples of writers who had misunderstood Darwin. The first "concludes with a charge of something like blindness, in your not seeing that Natural Selection requires the constant watching of an intelligent 'chooser,' like man's selection to which you so often compare it . . ." The second author

considers your weak point to be that you do not see that "thought and direction are essential to the action of Natural Selection". The same objection has been made a score of times by your chief opponents, and I have heard it as often stated myself in conversation. Now, I think this arises almost entirely from your choice of the term "Natural Selection" and

so constantly comparing it in its effects to Man's Selection, and also your so frequently personifying nature as "selecting," as "preferring," as "seeking only the good of the species," etc., etc. To the few this is as clear as daylight, and beautifully suggestive, but to many it is evidently a stumbling-block.

He adds, "It is evidently also necessary not to personify 'Nature' too much - though I am very apt to do it myself - since people will not understand that all such phrases are metaphors." Wallace suggested that Darwin could avoid the misunderstandings evoked

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by "natural selection" by adopting Spencer's phrase, "the survival of the fittest."

Darwin replied that he saw the point but added, "I formerly thought, probably in an exaggerated degree, that it was a great advantage to bring into connection natural and artificial selection; this indeed led me to use a term in common, and I still think it some advantage." He had just completed a new edition of the *Origin* which was already in the press. In any case, he added, "The term Natural Selection has now been so largely used abroad and at home that I doubt whether it could be given up, and with all its faults I should be sorry to see the attempt made. Whether it will be rejected must now depend 'on the survival of the fittest.' As in time the term must grow intelligible the objections to its use will grow weaker and weaker." Darwin did not take Wallace's friendly advice, and two years later Wallace published his reservations in a section entitled

"Mr. Darwin's Metaphors liable to Misconception."

The most widespread of the misconceptions played a very ironic part in the debate surrounding Darwin's theory. As Adam Sedgwick put it in a cordial but profoundly pained letter, "You write of 'natural selection' as if it were done consciously by the selecting agent." Sedgwick wanted to insist on the role of final causes in nature and asserted that natural laws were manifestations of the will of God. Like so many of those who seized on the anthropomorphic use of "natural selection," Sedgwick wanted to assimilate it to an active role for the Deity in sustaining and guiding the history of nature. Sedgwick was himself unable to adopt Darwin's theory, but many others were able to do so because they interpreted Darwin in the very sense which Sedgwick was advocating.

Charles Lyell was among Darwin's friendliest critics. It was one of Darwin's greatest hopes that his mentor would finally accept the theory, but Lyell vacillated and held back for ten years after its publication. His reservations about evolution were not confined to the difficulties which he had encountered in the *Principles of Geology* in reconciling it with his uniformitarian, equilibrium theory of the history of the earth. Like many others (some of whom objected to his geological theory on the same grounds), he was concerned about

the implications of evolution for the special status of man. He had made it very clear that the advent of man's moral nature was not a part of the ordinary course of the history

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of nature. It's worth recalling that he further guarded himself in saying that even if evolution could account for the history of *life*, the analogy could not be extended to include man. Lyell's general position was close to Darwin's on many matters, but his reservations about Darwin's theory were characteristically focused on the special status of man. He wrote about this to Darwin in 1859, and Darwin's reply begins with a reference to Lyell's worries.

"Must you not assume a primeval creative power which does not act with uniformity, or how could man supervene?" - I am not sure I understand your remarks which follow the above. We must, under present knowledge, assume the creation of one or a few forms in the same manner as philosophers assume the existence of a power of attraction without any explanation. But I entirely reject, as in my judgment quite unnecessary, any subsequent addition "of new powers and attributes and forces;" or of any "principle of improvement," except in so far as every character which is naturally selected or preserved is in some way an advantage or improvement, otherwise it would not have been selected. If I were convinced that I required such additions to the theory of natural selection, I would reject it as rubbish, but I have firm faith in it, as I cannot believe, that if false, it would explain so many whole classes of facts, which, if I am in my senses, it seems to explain.

He goes on to argue that the intellectual powers of man could, according to his theory, have evolved gradually, just as corporeal structures could. The entire argument of *The Descent of Man* is devoted to this point. Darwin's strategy is the same as it is in the *Origin* - to explain away apparent discontinuities by a judicious mixture of anecdote, rhetorical questions, and appeals to the uniformity of nature. This approach on Darwin's part was not unusual in the nineteenth century; nor, for that matter, are current writings in biology and psychology fundamentally different. It is difficult to see how they could be.

Darwin also attempted to neutralize Lyell's objection by allowing a role for God behind the laws.

One more word upon the Deification of Natural Selection: attributing so much weight to it does not exclude still more general laws, *ie* the ordering of the whole universe. I have said that Natural Selection is to the structure of organised beings what the human architect is to a building. The very existence of the human architect shows the existence of more general laws; but no one, in giving credit for a building to the human

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architect, thinks it necessary to refer to the laws by which man has appeared.

No astronomer, in showing how the movements of planets are due to gravity, thinks it necessary to say that the law of gravity was designed that the planets should pursue the courses which they pursue. I cannot believe that there is a bit more interference by the Creator in the construction of each species than in the course of the planets. It is only owing to Paley and Co., I believe, that this more special interference is thought necessary with living bodies. But we shall never agree, so do not trouble yourself to answer.

It is Darwin who returns to the question a year later.

When you come to "Deification," ask yourself honestly whether what you are thinking applies to the endless variations of domestic productions, which man accumulates for his mere fancy or use. No doubt these are all caused by some unknown law, but I cannot believe they were ordained for any purpose, and if not so ordained under domesticity, I can see no reason to believe that they were ordained in a state of nature. Of course, it may be said, when you kick a stone, or a leaf falls from a tree, that it was ordained, before the foundations of the world were laid, exactly where that stone or leaf should lie. In this sense the subject has no interest for me.

But when Lyell published his views on the subject in *The Antiquity of Man* (1863) he accused Darwin of deifying secondary causes:

In our attempts to account for the origin of species, we find ourselves still sooner brought face to face with the working of a law of development of so high an order as to stand nearly in the same relation as the Deity himself to man's finite understanding, a law capable of adding new and powerful causes, such as the moral and intellectual faculties of the human race, to a system of nature which had gone on for millions of years without the intervention of any analogous cause. If we confound "Variation" or "Natural Selection" with such creational laws, we deify secondary causes or immeasurably exaggerate their influence.

Lyell was here attempting to retain a role for the Deity above the operation of natural laws, and confined his belief in intervention to such major steps as the establishment of man's special status. Of course, much of the basis for reservations about evolution can be traced back to the special status of man, and the battlefields of geology and biology were given special meaning because of their location as outposts of the crucial central issue. Even so, in the realm of biology there seemed a relatively small distance separating

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Darwin from Lyell. The issue was a matter of how one chose to interpret natural laws - as self-acting or as expressions of the will of God.

Darwin had similar correspondences with a large number of friendly critics, each of whom seized on his language as a basis for arguing that the course of evolution was, after all, designed. The topic is one of the most recurrent ones in his correspondence. Again and again Darwin asks what is so different about his case from similar ones in the physicochemical sciences, and again and again his would-be interpreters try to reconcile his theory with design by means of the active role played by natural selection. Finally, in a letter to Hooker, Darwin's exasperation begins to show.

Such men as you and Lyell thinking that I make too much of a Deus of Natural Selection is a conclusive argument against me. Yet I hardly know how I could have put in, in all parts of my book, stronger sentences. The title, as you once pointed out, might have been better. No one ever objects to agriculturists using the strongest language about their selection, yet every breeder knows that he does not produce the modification which he selects. My enormous difficulty for years was to understand adaptation, and this made me, I cannot but think, rightly insist so much on Natural Selection.

It is clear from this and from many of the foregoing remarks by Darwin that the path by which he claimed to have come to his theory was causing grave difficulties and that, although he understood many of the objections, he was very unwilling to alter his mode of expression about natural selection. Although none of his correspondents was arguing for divine intervention in the crude form of catastrophist miracles, they were convinced that the course of evolution was guided by God's sustaining power and purposes. Darwin could grant this only if the Deity was identified with the principle of the uniformity of nature itself. At any lower level of abstraction he could not make any concessions, no matter how much his correspondents thought they were bringing about a diplomatic reconciliation between evolution and theology. Darwin had gone as far as he could in the *Origin* in arguing that the uniform operation of natural laws led to a grander view of the Creator. He thought it a paltry view of God to claim that He should tamper with the details of species. This point came out

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clearly in a letter to Sir John Herschel, who had called for a law of evolution in his correspondence with Lyell in 1837, and had criticized *Vestiges* for failing to supply a *vera causa*. Yet when Darwin's book appeared, he criticized natural selection as "the law of higgeldy-piggeldy" and expressed a preference for a law of "Providential Arrangement." Darwin wrote:

I am pleased with your note on my book on species, though apparently you go but a little way with me. The point which you raise on intelligent Design has perplexed me beyond measure; & has been ably discussed by Prof. Asa Gray, with whom I have had much correspondence on the subject. I am in a complete jumble on the point. One cannot look at this Universe with all living productions & man without believing that all has been

intelligently designed; yet when I look to each individual organism, I can see no evidence of this. For, I am not prepared to admit that God designed the feathers in the tail of the rock-pigeon to vary in a highly peculiar manner in order that man might select such variations & make a Fan-tail; & if this be not admitted (I know it would be admitted by many persons) then I cannot see design in the variations in structure of animals in a state of nature, those which were useful to the animal being preserved & those useless or injurious being destroyed. But I ought to apologise for thus troubling you.

In the remainder of the letter Darwin implies that the real problem for Herschel is that a new generation of scientists is coming along, and its members see nature in terms of unalloyed uniformity.

You will think me very conceited when I say I feel quite easy about the ultimate success of my views, (with much error, as yet unseen by me, to be no doubt eliminated); & I feel this confidence because I find so many young & middle-aged truly good workers in different branches, either partially or wholly accepting my views, because they find that they can thus group & understand many scattered facts. This had occurred with those who have chiefly or almost exclusively studied morphology, geographical distribution, systematic Botany, simple geology & paleontology. Forgive me boasting, if you can; I do so, because I should value your partial acquiescence in my views, more than that of almost any other human being.

Darwin could not expect acquiescence from the elder statesman of science, a man whose view of nature had been formulated in a period which assumed a perfect harmony between natural theology and natural science. Darwin and the members of his generation

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could accept theism only if its claims were so abstract as not to interfere with the operations of nature at all.

However, the growing success of evolutionary theory - including a lengthening list of converts eagerly compiled by Darwin in the period after his book appeared - was considerably aided by a group of scientists and scholars who held an intermediate position. Lyell's objections were the basis for his inability to embrace Darwin's theory, and Herschel's position was similar. Wallace, on the other hand, was attempting to prevent misunderstanding of the theory which he had coauthored. There was a group in the middle who accepted Darwin's theory and eagerly offered their services as mediators between evolution and a theistic view of nature. The list is a long one and includes such writers as the Duke of Argyll, whose *The Reign of Law* (1867) made a theistic interpretation of evolution easy to accept. Another would-be ally was Charles Kingsley, an eminent clergyman and botanist whose satirical *Water Babies* was written in the spirit of theistic naturalism. Kingsley wrote to Darwin in 1859,

I have gradually learnt to see that it is just as noble a conception of Deity, to believe that he created primal forms capable of self-development into all forms needful *pro tempore and pro loco*, as to believe that he required a fresh act of intervention to supply the *lacunas* which He himself had made. I question whether the former be not the loftier thought.

Darwin was so pleased that he included reference to Kingsley's remarks in later editions of the *Origin*, while Kingsley came to see that "all natural theology must be rewritten." This sort of position was not held only by amateur scientists. Indeed, one of the most eminent physiologists of the period, William B. Carpenter, took an active part in the debate, and the constant theme of his writings was the reconciliation of science with a theistic view of nature. His articles on the topic extend from reviews of the *Origin* into interpretive essays in the 1880s such as "The Force Behind Nature," "The Doctrine of Evolution in Its Relations to Theism," and "The Argument from Design in the Organic World." On the other side of the narrowing gap lay the writings of the polymath essayist, George Henry Lewes, whose books and articles attempted to prevent any inroads from theism into the domain of nature. For example, his review of the Duke of Argyll's *The Reign of Law* recognizes the narrowness of the gap and sets out to widen it, while

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his uncompromising, though rambling, series on "Mr. Darwin's Hypotheses" drives the point home.

But perhaps the most interesting of the scientists who attempted to interpret Darwin as a support for theism was Professor Asa Gray of Harvard. He was an enthusiastic advocate of Darwin's theory in America, and Darwin was very grateful for his support. It is in the correspondence with Gray that Darwin considers the theistic interpretation most carefully, and a review of it provides considerable support for the interpretation of the debate which is being urged here, i.e., that Darwin's position was ambiguous and that the reception of his theory was enhanced by that ambiguity. It will be recalled that Gray was one of the first people to whom Darwin told his secret and that a letter of 1857 to Gray was included in the joint Darwin-Wallace paper a year later. In the period after 1859 Gray was very active in publishing articles in which he argued that natural selection was not inconsistent with natural theology. He argued for a harmony between evolution and theology and advocated "Evolutionary Teleology." Darwin at first cautiously welcomed Gray's support and expressed uncertainty about his own position, but he finally concluded that he could not share Gray's hopeful view of nature. The first relevant letter was written in 1860.

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, and as I should wish to do, evidence of design and beneficence on all sides of us. There seems to me too much misery in the world. I cannot persuade myself that a

beneficent and 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, and especially the nature of man, and 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 and 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

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complex action of natural laws. A child (who may turn out an idiot) is born by the 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, and that all these laws, may have been expressly designed by an omniscient Creator, who foresaw every future event and consequence. But the more I think the more bewildered I become; as indeed I have probably shown by this letter.

A year later Darwin reverted to the subject in the light of Herschel's views:

I sent a copy to Sir J. Herschel, and in his new edition of his "Physical Geography" he has a note on the "Origin of Species," and agrees, to a certain limited extent, but puts in a caution on design - much like yours..... I have been led to think more on this subject of late, and grieve to say that I come to differ more from you. It is not that designed variation makes, as it seems to me, my deity "Natural Selection" superfluous, but rather from studying, lately, domestic variation, and seeing what an enormous field of undersigned variability there is ready for natural selection to appropriate for any purpose useful to each creature.

Three months later Darwin took up Gray's reply:

Your question what would convince me of Design is a poser. If I saw an angel come down to teach us good, and I was convinced from others seeing him that I was not mad, I should believe in design. If I could be convinced thoroughly that life and mind was in an unknown way a function of other imponderable force, I should be convinced. If man was made of brass or iron and no way connected with any other organism which had ever lived, I should perhaps be convinced. But this is childish writing.

I have lately been corresponding with Lyell, who, I think, adopts your idea of the stream of variation having been led or designed. I have asked him (and he says he will hereafter reflect and answer me) whether he believes that the shape of my nose was designed. If he does I have nothing more to say. If not, seeing what Fanciers have done by selecting individual differences in the nasal bones of pigeons, I must think that it is illogical to suppose that the variations, which natural selection preserves for the good of any being, have been designed. But I know that I am in the same sort of muddle (as I have said before) as all the world seems to be in with respect to free will, yet with everything supposed to have been foreseen or pre-ordained.

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After another three months Darwin was growing weary but without having seen his way to a clear position.

With respect to Design, I feel more inclined to show a white flag than to fire my usual long-range shot. I like to try and ask you a puzzling question, but when you return the compliment I have grave doubts whether it is a fair way of arguing. If anything is designed, certainly man must be: one's "inner consciousness" (though a false guide) tells one so; yet I cannot admit that man's rudimentary mammae . . . were designed. If I was to say I believed this, I should believe in the same incredible manner as the orthodox believe the Trinity in Unity. You say that you are in a haze; I am in thick mud; the orthodox would say in fetid, abominable mud; yet I cannot keep out of the question, My dear Gray, I have written a deal of nonsense.

After Darwin had thrashed out this issue with Lyell, Gray, and many others, it appears that he began to see that what he considered to be misinterpretations were, *in effect*, softening the blow of evolutionism and, paradoxically, gaining him adherents. After Lyell's *Antiquity of Man* appeared, he complained about Lyell's fence-sitting on the question of natural selection but expressed greater concern for the more fundamental issue: "Personally, of course, I care much about Natural Selection; but that seems to me utterly unimportant, compared to the question of Creation or Modification," *i.e.*, change of species by descent.

Over the next four years Darwin reached a fairly firm position and decided that he had to publish a clear statement of his views. He wrote to Hooker in 1867 that he thought it shabby to evade the question and that he had made a forthright statement at the end of his forthcoming book, *The Variation of Plants and Animals under Domestication*. In two long paragraphs he brings together the disclaimers which had been developed in his correspondence on the subject, and when he comes to the question in his *Autobiography* the reader is referred back to that statement. Characteristically, the argument is developed in terms of the relationship between artifice and the physical causes of the artificer's materials. Yet within a year the *Quarterly Review* contained an eloquent defense of design. It is interesting to notice that evolution and even natural

selection are seen as perfectly acceptable. The author insists, however, that these depend on design. An extra principle is needed

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over and above the natural laws, and the argument is supported by reference to Darwin's voluntarist language about natural selection. Darwin's metaphorical language is acknowledged to be figurative, but it is said to help us to see the ultimate dependence of evolution on design. The author, J. B. Mozley, concludes,

So on the field of Nature natural selection, supposing Mr. Darwin's theory of Progress to be true, cannot relieve us from the need of some prior principle, some intelligence, however mysterious, which has worked for an end in Nature, and under whose guidance this progress has proceeded . . . He must either make his theory rational, then, by the admission of design; or by the omission of design he must leave it a substantially epicurean hypothesis, accounting for the formation of the animal world by chance.

And so we come round to Paley again.

There is a double irony in this result. While Darwin grew increasingly unsympathetic to attempts to couple natural selection with a conception of design, it was Darwin's language which had given his interpreters a warrant for their views on designed evolution. However, their interpretations played an important role in *gaining* adherents among the intelligentsia to some theory of evolution. Although Darwin's original expression of the conception of natural selection may have been severely battered in the course of the period 1859-70, the ways in which Darwin's interpreters presented the theory was at the same time gaining ground for the more fundamental principle of the uniformity of nature. Whether the course of variation and selection was designed or not, it was increasingly accepted that nature acted according to uniform natural laws. Whether these were designed or not was a secondary matter for science. As Darwin had said in one of his letters to Lyell, at this level "the subject has no interest for me." He came to see that the interpretations which others sought to put on his theory were fundamentally harmless. As I argue in Chapter 5, the views of God's government of the universe became increasingly identified with the uniformity of nature, and this was in turn seen as a grander view of the Creator. Theology ceased to intervene in the course of science (leaving the field open to politics and ideology with disastrous results) and God ceased to be seen as intervening in the course of nature (leaving men to do so with appalling consequences).

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If we look ahead to the mid-1870s, there are signs of the benevolent tolerance of the victors. When, in 1874, Gray wrote that Darwin had done a "great service to Natural Science in bringing back to it Teleology: so that instead of Morphology *versus* Teleology, we shall have Morphology wedded to Teleology," Darwin commented, "What you say about Teleology pleases me especially, and I do not think any one else has ever noticed the point. I have always said you were the man to hit the nail on the head." Similarly, the aggressive tone which was characteristic of the notoriously provocative addresses of Huxley and Tyndall to the British Association meeting at Belfast in the same year contains, if we will look for it, a note of tolerance for the believer as long as science could be allowed to get on with its "unrestricted right of search" throughout nature, including human nature. Finally, if we look wider afield to J. S. Mill's essay "Theism" (1874, written 1868-70 and intended for publication in 1873), we find that he was judicious and gentle in his treatment of natural theology and very generous and tolerant about the consolations of theism. The *enfant terrible* of the early days of the *Westminster Review* could afford to be generous in an age of the triumph of the uniformity of nature. What Newtonianism and its analogies in psychology, politics, and social theory had failed to bring about - including man and society in the domain of natural law - had finally been achieved by the patience of someone who could somehow integrate Paley and Malthus (both in their ways representatives of the naturalistic movement in its utilitarian aspect). If Darwin had cynically designed natural selection device for speciously aiding the advance of the uniformity of nature, he could not have selected a better contrivance. But, of course, deviousness had no place in Darwin's character, any more than did the desire to offend sincere believers. In the last letter he ever wrote to Wallace we find him warmly recommending *The Creed of Science*, a book which raised all the specters science had been alleged to have called forth, only to reassure the reader that all was after all well with man and God and nature. Darwin recommended the book to his friends and wrote to the author, William Graham, to say, "It is a very long time since any other book has interested me so much." And adds, "... you have expressed my inward conviction, though far more vividly and clearly than I could have done, that the Universe is not the result of chance." Graham had written,

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We are compelled to interpret the course of evolution as being under guidance; to believe that the final results were aimed at; that Nature did not stumble on her best works by sheer accident, the further results of which would have utterly astonished herself had she eyes to see. Let us freely grant that intention, design, or plan and purpose which we must read into nature, and which we must suppose in some way to be there, is and must be very different from ours, only remotely analogous to ours because we cannot postulate the existence of a Person in which it resides; but yet we must use the notion of design, because the only alternative, chance, is still wider away from the facts. If we must elect between the two agencies, chance and design, the latter must be nearer the truth. Design we know already

in our case to be a true shaping power, while chance effects nothing but evil in the long run. Chance, as an explanation - and if design be denied, chance must be offered as the explanation - is a word expressing nothing, a word which, under pretence of explanation, affirms nothing whatever. It is this; but it is also much more serious; for it is the express denial of God and it is thus genuine atheism.

Before turning to the second aspect of the vicissitudes of Darwin's metaphor, it may be illuminating to record another vignette reflecting Darwin's ambiguous position. The Duke of Argyll recorded a conversation with Darwin in the last year of his life, in which Argyll remarked that when he contemplated the remarkable contrivances recorded in Darwin's books on earthworms and orchids, he found it impossible to do so "without seeing that they were the effect and the expression of mind. I shall never forget Mr. Darwin's answer. He looked at me very hard and said, 'Well, that often comes over me with overwhelming force; but at other times,' and he shook his head vaguely, adding, 'it seems to go away.'"

VII

Having considered some of the theological and philosophical issues which arose in the scientific debate on Darwin's theory, one could provide a similarly detailed exposition of a related and straightforwardly scientific controversy over the mechanism of natural selection. Fortunately, however, this is largely unnecessary, since it has received close attention from historians of biology. I shall therefore confine myself to summarizing the debate and relating it to the foregoing account. Another way of putting the views of those who argued on theological and philosophical

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grounds that Darwin's theory required or even implied design was to say that natural selection was not a *vera causa*. I said earlier that one of Darwin's reasons for pitching his argument in abstract and metaphorical terms was that he was frankly and profoundly ignorant of both the causes of variation and the precise means by which favorable variations were preserved and accumulated. That is, he really had no *mechanism* at all. A crude and anachronistic way of putting this is to say that he lacked a particulate theory of heredity, a distinction between somatic and germ cells, and a concept of dominance. In short, he lacked genetics and molecular biology. These deficiencies are too crude to remain unqualified, since at various times he considered theories which implied adumbrations of all of these modern conceptions, particularly in the theory of "Pangenesis" which he developed in *The Variation of Plants and Animals under Domestication*. However, the attempts on Darwin's part to provide a satisfactory theory of inheritance did not prevent him from progressively modifying the emphasis of his overall theory, and the reader can safely be referred to the discussion by Vorzimmer and the thorough study by Geison on this topic. For present purposes it is sufficient to point out that critics who were not wholly unsympathetic to Darwin showed that even a metaphorical

mechanism could not explain how favorable variations could get established and accumulate in the history of a given race. The problem was variously described as that of swamping, blending, dilution, or the uselessness of incipient structures. It is ironic that the root objection underlying all these criticisms was the same as that used by Paley to dismiss Erasmus Darwin's theory of evolution over half a century earlier. (In Darwin's time it was even used to criticize the argument of Kingsley's *Water Babies*.)

Just as he had been an early critic of Darwin's analogy between artificial and natural selection, the coauthor of the theory was art among the first to abandon belief in the total efficacy of natural selection. However, Wallace's partial defection can best be described as a loss of faith in the plausibility of the principle of utility as an adequate way of accounting for the development of certain key structures in man. Wallace went on to advocate creative intervention at crucial stages in the history of nature - the appearance of organized matter, consciousness, and man's higher faculties. When Lyell finally accepted Darwin's theory in 1868, it was a hollow victory, since Wallace reviewed the relevant edition of Lyell's

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Principles in the *Quarterly Review* and used the notice as an occasion for putting his views on the limits of natural selection as an explanatory principle, before the general public. Although Wallace's views were grievously disappointing to Darwin, they were not supported by compelling arguments, and Darwin could only lament his colleague's increasing movement toward spiritualism in his philosophy of nature and voluntarism in his philosophy of man and society. Wallace had objected to the anthropomorphism of Darwin's descriptions of natural selection only to embrace the guidance of a "superior intelligence" in his later views on the evolution of man.

At an early stage Darwin had seen the difficulties involved in his theory and the danger that it could not account for the means by which variations avoided being swamped in the general population, and he had formulated his (ultimately unsuccessful) Pangenesis hypothesis before well-developed objections had been published. (The problem had been raised in a review of the *Origin* in 1860 and had worried both Gray and Huxley.) Even so, the public first became properly aware of the problem in 1867, when Fleeming Jenkin wrote an unpolemical and closely reasoned critique of natural selection, which appeared in the *North British Review*. This was reinforced four years later by St. George Jackson Mivart's *Genesis of Species*, which reiterated Jenkin's arguments. Jenkin employed an elegant example of a white man shipwrecked on an island of Negroes and showed by clear probabilistic reasoning that it was inescapable that his color and his other attributes - however undoubtedly "superior" - would be swamped by the rest of the population in a number of generations. Mivart's volume developed the problem of the inutility of incipient structures. Both of these authors noted that Darwin had spoken metaphorically about natural selection, but this was not their chief concern. Rather, they were at pains to point out the obvious insufficiency of Darwin's putative causes for evolutionary change. Finally,

as if Darwin didn't have troubles enough, the physicists set about robbing him of the limitless drafts of time which Lyell's geology had provided. Sir William Thomson (later Lord Kelvin) presented evidence from calculations about the age of the sun which severely restricted the geological time scale, and both Jenkin and Mivart added this point to their already-formidable list of objections. Thus, even if Darwin's mechanism did not fail because of blending or the inutility of incipient structures, it did not have enough time in which to

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work. Darwin saw this as one of the most worrying objections which had been put forward.

Darwin had been thinking about the problem of blending since the 1840s and was making various moves to shore up his theory when Jenkin's attack appeared. His response was to beat an orderly retreat by allowing increasing roles for the inheritance of acquired characters, the direct action of the environment, sexual selection, and other causes. It is important to see this change in its proper perspective. Darwin's theory is usually considered to have gained the attention of the scientific community largely because he had, at last, specified a *cause* for evolution. Natural selection set his theory apart from the theories of all the others. Before Darwin, as Huxley pointed out in his review of the *Origin* in the *Times*, evolution had been "a 'skeleton in the closet' to many an honest zoologist and botanist." In his fuller treatment of the book in the *Westminster Review*, he reflected the change in atmosphere: natural selection was "the only exant hypothesis which is worth anything in a scientific point of view." Ten years later, G. H. Lewes pointed out that earlier hypotheses had failed to move most scientists but that "minds unconvinced by all such attempts were at once subdued by the principle of Natural Selection, involving as it did, on the one hand, incontestable Struggle for Existence, and on the other, the known laws of Adaptation and Hereditary Transmission." Whatever claims Darwin and others may have made later about the role of other factors, it is clear both from the title of the book and from reiteration throughout the text that the success of his theory depended overwhelmingly on the faith which he could elicit in natural selection.

Darwin presented a brave, even slightly taunting, front. Paley had suggested that contemplation of the eye was a cure for atheism: such a beautiful and complex structure could only have been contrived by an Omnipotent Designer. Darwin took up this point in his chapter, "Difficulties on Theory," in a section entitled "Organs of Extreme Perfection and Complication."

To suppose that the eye, with all its inimitable contrivances for adjusting the focus to different distances, for admitting different amounts of light, and for the correction of spherical and chromatic aberration, could have been formed by natural selection, seems, I freely confess, absurd in the highest possible degree. Yet reason tells me, that if

numerous gradations from a perfect and complex eye to one very imperfect and simple, each grade being useful to its possessor, can be shown to exist; if further, the

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eye does vary ever so slightly, and the variations be inherited, which is certainly the case; and if any variation or modification in the organ be ever useful to an animal under changing conditions of life, then the difficulty of believing that a perfect and complex eye could be formed by natural selection, though insuperable by our imagination, can hardly be considered real.

In private Darwin was less confident. He wrote to Gray in 1860, "I remember well the time when the thought of the eye made me cold all over, but I have got over this stage of the complaint, and now small trifling particulars of structure often make me very uncomfortable. The sight of a feather in a peacock's tail, whenever I gaze at it, makes me sick!" As he began to give increasing weight to other factors, he was certainly aware of detracting from the unity and simplicity of his theory. He wrote to Hooker in 1862 (in a letter which was later seized upon by a critic), "I hardly know why I am a little sorry, but my present work is leading me to believe rather more direct [*sic*] in the actions of physical conditions. I presume I regret it, because it *lessens the glory of natural selection*, and is so confoundedly doubtful." By 1876 he was convinced that there is an important role for the direct action of the environment and regretted that he had not seen this in the period in which he wrote the *Origin* and for some years after. In the intervening period he had also allowed an increasing role for the inheritance of acquired characteristics. Indeed, one of his most eloquent defenders later pointed out that "Darwin's acceptance of the theory of use-inheritance was vitally essential to his theory of Pangenesis - that 'beloved child' over which he had 'thought so much as to have lost all power of judging it.'"

Once Darwin had decided that he would have to supplement natural selection with a number of other factors, he was quite explicit about the change. In the sixth and last edition of the *Origin* (1872), he altered the first paragraph of his conclusion to read as follows:

I have now recapitulated the facts and considerations which have thoroughly convinced me that species have been modified, during a long course of descent. This has been effected chiefly through the natural selection of numerous successive, slight, favourable variations; aided in an important manner by the inherited effects of the use and disuse of parts; and in an unimportant manner, that is in relation to adaptive structures, whether past or present, by the direct action of external conditions, and

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by variations which seem to us in our ignorance to arise spontaneously. It appears that I formerly underrated the frequency and value of these latter forms of variation, as leading to permanent modifications of structure independently of natural selection. But as my conclusions have lately been much misrepresented, and it has been stated that I attribute the modification of species exclusively to natural selection, I may be permitted to remark that in the first edition of this work, and subsequently, I placed in a most conspicuous position - namely, at the close of the Introduction - the following words: "I am convinced that natural selection has been the main but not the exclusive means of modification." This has been of no avail. Great is the power of steady misrepresentation; but the history of science shows that fortunately this power does not long endure.

Having done his best to make his modified position clear in the last edition of the *Origin*, he forcefully repeated the point as the only substantive issue raised in the short preface to the second edition of *The Descent of Man* (1874):

I may take this opportunity of remarking that my critics frequently assume that I attribute all changes of corporeal structure and mental power exclusively to the natural selection of such variations as are often called spontaneous; whereas, even in the first edition of the "Origin of Species," I distinctly stated that great weight must be attributed to the inherited effects of use and disuse, with respect both to the mind and body. I also attributed some amount of modification to the direct and prolonged action of changed conditions of life. Some allowance, too, must be made for occasional reversions of structure; nor must we forget what I have called "correlated" growth, meaning, thereby, that various parts of the organisation are in some unknown manner so connected, that when one part varies, so do others; and if variations in the one are accumulated by selection, other parts will be modified. Again, it has been said by several critics, that when I found that many details of structure in man could not be explained through natural selection, I invented sexual selection; I gave, however, a tolerably clear sketch of this principle in the first edition of the "Origin of Species," and I there stated that it was applicable to man. This subject of sexual selection has been treated at full length in the present work, simply because an opportunity was here first afforded me. I have been struck with the likeness of many of the half-favourable criticisms on sexual selection, with those which appeared at first on natural selection; such as, that it would explain some few details, but certainly was not applicable to the extent to which I have employed it. My conviction of the power of sexual selection remains unshaken; but it is probable, or almost certain, that several of my conclusions will hereafter be

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found erroneous; this can hardly fail to be the case in the first treatment of a subject.

Twenty years later, in the clearest contemporary exposition of the issues as they were seen by scientists in the nineteenth century, George J. Romanes stressed the later

development of Darwin's views and added that "the longer he lived, and the more he pondered these points, the less exclusive was the *role* which he assigned to natural selection, and the more importance did he attribute to the supplementary factors above named [the same ones listed above]. This admits of being easily demonstrated by comparing successive editions of his works, a method adopted by Mr. Herbert Spencer in his essay on the *Factors of Organic Evolution*."

Spencer's views pose a revealing contrast to Darwin's. He firmly believed that the inheritance of acquired characteristics was far more important in the higher stages of evolution than natural selection. He related this point to his grand scheme of universal evolution and its application to man and society; his scheme in fact depended on the validity of use-inheritance. His essay on Darwin's retreat was marvelously catty, and he developed the point further in a series of essays which began with one entitled "The Inadequacy of Natural Selection." Spencer pointed out the difficulties involved in making the analogy from artificial to natural selection and reproduced the usual objections based on the uselessness of incipient structures and on swamping, but he had a more basic motive for opposing natural selection in the evolution of man, and it is for this reason that he returned again and again to the issue.

I have, indeed, been led to suspend for a short time my proper work, only by consciousness of the transcendent importance of the question at issue. As I have before contended, a right answer to the question whether acquired characters are or are not inherited, underlies right beliefs, not only in Biology and Psychology, but also in Education, Ethics, and Politics.

The context within which Spencer - and Wallace - saw the problem of the mechanism of evolution should be contrasted with that of Darwin. Wallace and Spencer can be said to have held and modified their evolutionary views on the basis of philosophical, social, and political theories. There is no obvious basis for attributing Darwin's changing views to such factors, but the point to be noted here is that they did change considerably. Darwin changed at least

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as much as the oft-criticized Wallace and a long way in the direction of Spencer, whose views are usually sharply contrasted with Darwin's. Like the true gradualist that he was, Darwin modified passages in successive editions of the *Origin* as the objections arose. Of course, not all of the textual modifications were concerned with natural selection, while others contained answers to objections. But some idea of the amount of modification which his theory underwent can be seen from the findings of the editor of the variorum edition of the *Origin*: "Of the 3,878 sentences in the first edition, nearly 3,000, about 75 per cent, were rewritten from one to five times each. Over 1,500 sentences were added, and of the original sentences plus these, nearly 325 were dropped. Of the original and added

sentences there are nearly 7,500 variants of all kinds. In terms of net added sentences, the sixth edition is nearly a third as long as the first." The editions from the first to the sixth included ever-increasing revisions. Of the total, 7 percent appeared in the second edition (1859), 14 percent in the third (1861), 21 percent in the fourth (1866), 29 percent in the fifth (1869), and the sixth (1872) - including extensive replies to Mivart - had even more. It is a useful exaggeration to say that by the sixth edition the book was mistitled and should have read *On the Origin of Species by Means of Natural Selection and All Sorts of Other Things*.

The scientific difficulties in the way of natural selection continued to increase. When one of its most ardent exponents, Professor A. Weismann, wrote an article in 1893 entitled "The All-Sufficiency of Natural Selection," Spencer happily pointed out that it contained the following "admission which he has himself italicised, 'that *it is really very difficult to imagine this process of natural selection in its details*;' and to this day it is impossible to demonstrate it in any one point." As a result of successive theoretical and experimental developments in biology which seemed inconsistent with Darwin's mechanism of natural selection, this aspect of his theory went into increasing decline, so much so that Nordenskiöld's standard *History of Biology* (written in 1920-4 and still in print) included long chapters chronicling the decline of Darwinism, in the same period a evolution was being increasingly accepted. "To raise the theory of selection, as has often been done, to the rank of a 'natural law' comparable in value with the law of gravity established by Newton is, of course, quite irrational, as time has already shown; Darwin's theory of the origin of species

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was long ago abandoned." Within ten years, however, biologists were generally convinced that Darwin had been right in the first place, and numerous Nobel Prizes have been awarded to scientists who have worked out the details of the finer mechanisms of the theory of evolution by natural selection, and natural selection alone. More than that: genetic engineering is providing the basis for the next industrial revolution. But in the period which lay between the mid-1860s and the 1930s, it became increasingly unorthodox to object to evolution per se: the uniformity of nature was progressively assumed to apply to the history of life, including the life and mind of man. There was an ongoing debate about the mechanism or mechanisms by which this occurred, but the basic point was accepted.

VIII

Beginning in 1863, with the publication of Lyell's *Antiquity of Man* and Huxley's *Man's Place in Nature*, the debate increasingly focused on the question of the applicability of evolution to man. When Darwin's *Descent of Man* appeared in 1871, there was a brief revival of the intense controversy which had raged over *Vestiges* in the late 1840s and

over the *Origin* in the early 1860s. This controversy should be studied in its own right, but for present purposes it should be noticed that the main reviews of *Descent* all of the available objections to Darwin's mechanism - and welcomed Wallace's defection on the subject of man's origins. However, it is noteworthy that neither W. B. Dawkins in the *Edinburgh Review* nor Mivart in the *Quarterly* concentrated their attacks on the theory of evolution itself: it was the adequacy of natural selection and the application of evolution to man's mental nature that they opposed. But the vehemence of their opposition on these issues is complemented by tacit acceptance of evolution in general. In the *Contemporary Review*, Alexander Grant expressed milder objections to natural selection as an explanation of man's higher intellectual powers, but he could still claim that Darwin's work "might be described as a system of Natural Theology founded on a new basis" Most of the antagonists in the debate ceased to question evolution well before Darwin's *Descent of Man* appeared. G. H. Lewes' passionate defense of "Mr. Darwin's Hypotheses" in the *Fortnightly Review* had not insisted on natural selection, only evolution itself,

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while a highly critical answer to Lewes by J. B. Mozley in the *Quarterly* (as we have formerly remarked) accepted those two propositions and only added the need for design. Furthermore, the deliberations of some of the most eminent scientists, philosophers, editors, and men of affairs in the period at the meetings of the Metaphysical Society (1869-80), led to the common conclusion that "The uniformity of Nature is the veil behind which, in these latter days, God is hidden from us."

But what remains to be said about Darwin's metaphor? In the only comprehensive study of the reception of Darwin's theory, Ellegard points out that natural selection was not crucial to the general acceptance of evolution and that there was very little mention of it in the popular press. I hope that I have shown that Ellegard's claim is true only in a very complex sense. Those who interpreted Darwin for the intelligentsia made a very close analysis of natural selection, but Darwin's mode of writing about it made it possible for them to present the theory of evolution in a way which was near enough to their theological beliefs to allow acceptance of the uniformity of nature as applied to the history of life. There were important demarcation disputes about the extent to which the theory could be applied to man and mind, but the message which was passed to the popular press was, in the end, fundamentally reassuring. The so-called mechanism was essential in finally gaining a fair hearing for evolution in 1859 and was again essential after the establishment of the modern neo-Darwinian theory over half a century later. Of course, the interpretations which Darwin's language permitted were, at bottom, inconsistent with the basis of his theory in chance and trial and error, and Mivart was quite right to point out in his review of Darwin's *Life and Letters* that "it is clear and indisputable that the Darwinian hypothesis was one essentially opposed to the assertion of a purpose or design in nature . . ."

Nevertheless, the fortunes of evolutionism certainly benefited from a sort of creative confusion on the part of Darwin's readers and to some extent on his own part.

It is clear that Darwin's putative mechanism of natural selection suffered grievously for philosophical, theological, and scientific reasons - and often for all three - at the hands of critics who combined their reservations and/or their enthusiasms. But, as they concentrated on skirmishes the main issue was settled. Putting the matter another way, Darwin's mechanism - in its nineteenth-

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century form and in its nineteenth-century context - turned out to be a very frail reed, but in bending with the winds it allowed his real commitment to the uniformity of nature to contribute to the general movement of nineteenth-century naturalism. If we notice the extent to which the special status of natural selection was weakened by scientists, theologians, and philosophers, Darwin's achievement turns out to be much more like that of Lyell and of the other evolutionists: together, by a rather confused mixture of metaphysical, methodological, and scientific arguments which depended heavily on analogical and metaphorical expressions, they brought the earth, life, and man into the domain of natural laws.

Looking at the issue from the point of view of the intellectual history of the period, I hope that I have provided evidence for the utility of probing deeper into the scientific debate in order to better understand the wider issues in the thought of the period. If we begin with the most straightforward and "scientific" aspect of the theory and go on to look at its vicissitudes in the scientific controversy and the interpretations which it is given in the wider debate we are led by insensible stages from the supposedly internalist facts and theories of science to psychological, theological, social, and related issues in the philosophies of God, man, and nature. At a more general level, it is worth considering whether or not any fundamental scientific theory can be accurately represented as a pure, positivist discovery, free from the sorts of factors which are clearly involved in the case of natural selection. If we ask this question persistently enough, we may learn something about the nature of science itself, and thereby illuminate the way societies set agendas in their broad culture, including science, as part of the pursuit of social priorities and values.

IX

As an epilogue I should like to relate Darwin's influence to wider issues by means of renderings by three of the most sophisticated writers of the period which conveyed the meaning of evolution to the reading public. These remarks may help to show how far-reaching was the influence of evolutionary theory and illustrate the claim that the main purpose of the argument - support for the philosophical principle of the uniformity of nature - was the

message which was most pervasively felt at all levels of the thought of the period.

In 1847, three years after the appearance of *Vestiges*, Benjamin Disraeli published a novel entitled *Tancred* (the last of his "Young England" trilogy). The eponymous hero calls on young Lady Constance, and the following conversation takes place:

After making herself very agreeable, Lady Constance took up a book which was at hand, and said, "Do you know this?" And Tancred, opening a volume, which he had never seen and then turning to its title-page, found it was "The Revelations of Chaos," a startling work just published, and of which a rumour had reached him.

"No," he replied: "I have not seen it."

"I will lend it you, if you like; it is one of those books one must read. It explains everything, and is written in a very agreeable style."

"It explains everything!" said Tancred; "it must, indeed, be a very remarkable book!"

"I think it will just suit you," said Lady Constance. "Do you know, I thought so several times while I was reading it."

"To judge from the title, the subject is rather obscure," said Tancred.

"No longer so," said Lady Constance. "It is treated scientifically; everything is explained by geology and astronomy, and in that way. It shows you exactly how a star is formed; nothing can be so pretty! A cluster of vapour - the cream of the milky way - a sort of celestial cheese - churned into light - You must read it, 'tis charming."

"Nobody ever saw a star formed," said Tancred.

"Perhaps not. But you must read the 'Revelations'; it is all explained. But what is most interesting, is the way in which man has developed. You know, all is development. The principle is perpetually going on. First, there was nothing, then there was something; then - I forget the next - I think there were shells, then fishes; then we came - Let me see - did we come next? Never mind that; we came at last. And the next change will be something very superior to us - something with wings. Ah! that's it: we were fishes, and I believe we shall be crows. But you must read it."

"I do not believe I ever was a fish," said Tancred.

"Oh! but it's all proved: you must not argue on my rapid sketch; read the book. It is impossible to contradict anything in it . You understand, it is all science, it is not like those books in which one says one thing and another the contrary, and both may be wrong. Everything is proved -by geology, you know. You see exactly how everything is made, how many worlds there have been; how long they lasted; what went before, and what comes next. We are a link in the chain, as inferior animals were

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that preceded us: we in turn shall be inferior; all that will remain of us will be some relics in a new red sandstone. This is development. We had fins we may have wings."

In garbling the details and satirizing the *Vestiges*, Disraeli still conveys the essential sweep of Chambers' argument.

Twenty years later, G. H. Lewes pointed out the close affinity between Chambers' views and the Duke of Argyll's gloss on Darwin's theory in *The Reign of Law*:

I am perfectly serious, and very far from implying a shadow of doubt respecting the Duke's orthodoxy, in thus likening the "Reign of Law" to the "Vestiges." What the theological creed of the anonymous author of the "Vestiges" may have been we cannot decisively affirm; nor have we any concern with it. The idea which alarmed theological Britain - and justly alarmed it - was the idea which runs through the Duke of Argyll's work, namely, that everywhere throughout Nature - including therein all moral and social phenomena - the processes are subordinated to unchangeable Law; and that the whole universe, physical and moral, is the Development of a Plan, or Creative Purpose, which may - to some extent at least - be ascertained by Science. Not only is this the fundamental thesis of both works, it leads both writers to conclusions which in the "Vestiges" excited bitter wrath, and in the "Reign of Law" (perhaps because less salient, perhaps also because no longer novel) leave the public unagitated.

Finally, if we look opposite Lewes as he wrote, we find the woman who put these remarks into the mouth of Dorothea Brooke's loquacious uncle:

"I went into science a great deal myself at one tme; but I saw it would not do. It leads to everything; you can let nothing alone."

POSTSCRIPT.

I would be disappointed if people followed Gillian Beer in finding this essay limited because it focuses on a systematic study of a single metaphor "in isolation." She says, "Indeed, the limits of Robert Young's thorough and subtle essay 'Darwin's Metaphor: Does Nature Select?' are indicated in his insistence on one metaphor in isolation, whereas

interaction and the formation of significance takes *[sic]* place not only within a single metaphor but *between metaphors sustained in narrative.*"

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I did not set out to study metaphor in Darwin and run out of puff after studying that of "Natural Selection." My aim, as the quotation from George Eliot was intended to imply, and as my opening remarks made explicit ("the scientific heart of the theory raised fundamental philosophical and theological issues") was to show that the central concept - the explanatory principle - in the theory that binds all of life together and defines its relations with the rest of nature, was anthropomorphic, deeply ambiguous, and amenable to all sorts of readings and modifications. My aim was not to use literary spectacles to read Darwin but - consistent with Gillian Beer's treatment of Darwin as literature - to show that scientific, theological, philosophical, and ideological issues are all part of a common culture. It leads to everything, just as Dorothea's uncle says, and George Eliot's fiction was a deep exploration of the human meanings of the vicissitudes of naturalism. She was working in intellectual - as in personal - intimacy with George Henry Lewes. In pursuing this metaphor so thoroughly, I hoped to shed light on the largest issue of all - the meaning of life and of human attempts to think about it in a single culture. The title of this book is modified from that of this essay in order to convey that at the heart of its science we find a culture's values. Both are irreducibly anthropomorphic and social.