

# The Faith of Darwinism

By Marjorie Grene

*"Vainly did we philosophers and critical theologians over and over again decree the extermination of miracles, our ineffectual sentence died away, because we could neither dispense with miraculous agency, nor point to any natural force able to supply it, where it had seemed most indispensable. Darwin has demonstrated this force, this process of Nature; he has opened the door by which a happier coming race will cast out miracles, never to return. Everyone who knows what miracles imply will praise him, in consequence, as one of the greatest benefactors of the human race."*

THUS wrote the Biblical critic David Strauss in *The Old Faith and the New*, published in English translation in 1873 and quoted by Gertrude Himmelfarb in her *Darwin and the Darwinian Revolution*.<sup>\*</sup> The sixties and seventies saw, not only the triumph of Darwinism over religion, but the rise of Darwinism as religion: as a religion of humanity, impelled by the inhumanity of literal Christian belief. Darwin, though himself only partly a Darwinian, yet set the tone for this aspect of the Darwinian cult in his autobiography—in a passage suppressed by his widow and included in the new complete edition:

I can indeed hardly see how anyone ought to wish Christianity to be true; for, if so, the plain language of the text seems to show that the men who do not believe, and this would include my Father, Brother and almost all my best friends, will be everlastingly punished. And this is a damnable doctrine.

This "damnable doctrine" of Christianity has been the target of evolutionary ethics from the early T. H. Huxley to Julian Huxley, George Gaylord Simpson, or Theodosius Dobzhansky in the present generation. Sin, punishment, the last vestige of the jealous Hebrew god, such thinkers feel, have been vanquished under the

benevolent banner of purely naturalistic nature, unplanned and therefore unresentful. So we have, for instance, Julian Huxley's "morality of evolutionary direction":

Anything which permits or promotes open development is right, anything which restricts or frustrates development is wrong.

Some Darwinians, it is true, deny this ethical implication of Darwinism. T. H. Huxley, in his later years, denied it; so does the British naturalist David Lack in a recent book called *Evolutionary Theory and Christian Belief: The Unresolved Conflict*. For such thinkers, Darwinian nature, which scientific conscience compels them to accept, is the blind ongoing of fact indifferent to value and incapable of generating value. Morality must maintain itself, on this view, not within, but against the evolutionary stream. But this is, on the whole, an exceptional view; the humanitarian *Leitmotif* has been a genuine force in the origin and spread of Darwinism.

Yet this is only half the story, and the lesser half. It is as a *religion of science* that Darwinism chiefly held, and holds men's minds. The derivation of life, of man, of man's deepest hopes and highest achievements, from the external and indirect determination of small chance errors, appears as the very keystone of the naturalistic universe. And the defence of natural selection appears, therefore, as the defence of the integrity, the independence, the dignity of science itself. In this spirit T. H. Huxley first rose to its defence:

... I have said that the man of science is the sworn interpreter of nature in the high court of reason. But of what avail is his honest speech, if ignorance is the assessor of the judge, and prejudice the foreman of the jury? ... To those whose life is spent, to use Newton's noble words, in picking up here a pebble and there a pebble on

<sup>\*</sup> Chatto & Windus. 42s.

the shores of the great ocean of truth—who watch, day by day, the slow but sure advance of that mighty tide, bearing on its bosom the thousand treasures wherewith man ennobles and beautifies his life—it would be laughable, if it were not so sad, to see the little Canutes of the hour enthroned in solemn state, bidding that great wave to stay, and threatening to check its beneficent progress. . . . Surely, it is the duty of the public to discourage anything of this kind, to discredit these foolish meddlers who think they do the Almighty a service by preventing a thorough study of His works.

Thus, a century ago, Darwinism against Christian orthodoxy.

To-day the tables are turned. The modified, but still characteristically Darwinian theory has itself become an orthodoxy, preached by its adherents with religious fervour, and doubted, they feel, only by a few muddlers imperfect in scientific faith. Sir Gavin de Beer's great classic *Embryos and Ancestors*, for example, presents in brilliant array a host of embryological data bearing on evolution, but with no apparent relevance to the process of natural selection. Yet he concludes the third edition:

It is now recognised that evolution is the result of selection acting on heritable variation in the form of mutation and recombination of Mendelian genes. *These processes must have been at work in all the evolutionary changes considered in this book.* The morphological modes describe aspects of the course which the changes took, *but it was variation and selection which caused them.* (my italics)

And accordingly, in his centennial essay in *Endeavour*, Sir Gavin assures us that

. . . with the same confidence as it accepts Copernicus's demonstrations of the movement of the Earth round the sun and Newton's formulation of the laws of this movement, science can now celebrate the centenary of the first general principle to be discovered applicable to the entire realm of living beings.

Biology, thanks to Darwin (with assistance, indeed, from the rediscoverers of Mendel), has at last matured into a proper science, "Lamarck nonsense" is disinherited, old metaphysical follies re-echo only distantly in the ears of a few foolish mystics. Branches of biology once disparate—paleontology, embryology, ecology, taxonomy, genetics—converge on the new, great synthesis. Matter becoming life (and mind) through natural selection of small chance mutations; life spreading in ever new directions through opportunistic exploitation of the unexpected: of new niches in nature happening to fit a slightly new departure in the arrangement

of established genotypes, or slightly new genotypes happening to tumble into hitherto unexploited environments—this is the vision which experiment and mathematics, field observation and its statistical analysis combine to support.

THERE was a time, about the turn of the century, when the concept of mutation—i.e. of a sudden change in the structure of the germ plasm—appeared to contradict Darwin's view of a slow and gradual process in which slightly less fit variations were eliminated in favour of the slightly better adapted. But beginning with Sir Ronald Fisher's *Genetical Theory of Natural Selection* in 1930 there has arisen a most imposing synthesis of these two conceptions. Darwin did not know whether inheritance was blending or particulate—whether variations once occurring were or were not assimilated in some unknown way into the material of inheritance. Mendel, whose work lay buried till the early 20th century, had, in fact, in Darwin's lifetime proved the particulate basis. This seemed at first to mean that variations, for the use of evolution, are sudden and large, and not minute and gradual as Darwin imagined. What Fisher saw, however, was (1) that particulate inheritance retains variations for selection to work on, as blending inheritance would not, and (2) that it is not the changes in individuals that matter, for the purposes of evolution, but the changes in populations—and these *are* gradual. For if you have an active interbreeding population, say, of a thousand fruit flies, and you get a changed gene, say, for eyeless, in one chromosome in one of them, the proportion will now be 999 normal flies to one containing the mutation (and the corresponding change in the genes will be to 1,999 of the normal *allele* and one of the mutated form); in the next generation you may have 998 to two (or 1,998 normal genes to two mutated ones) and so on. This kind of change in a population is usually, and can be, very gradual; and it is measurable by statistical methods. In fact this measurement is said to *be* the measure of selective intensity—the change in Mendelian proportions in a population *is* natural selection, or genetical selection, as it is more properly called, and Darwinism is vindicated.

Yet surely, one may protest, Darwin's theory had to do with the "preservation of favoured races," the survival of the fittest and all that. On the face of it, these changing Mendelian ratios seem to have no connection with increasing adaptation, or the elimination of the unfit, or anything of the sort. Yet here, too, the modern theory is more Darwinian than Darwin himself. "Evolution," Fisher says, "is progressive adaptation and consists in nothing else." And life itself is evolution: populations evolving,

fitting in here and there, weeding themselves out here and there, as changing opportunities appear and disappear. That is what selective intensity measures; for what else could it conceivably be measuring? Darwin excepted some characters from this rule, seeing no reason to consider them advantageous or otherwise. But modern ecological methods have greatly amplified and codified the relevant data, and have proved even some of Darwin's exceptions—notably, for instance, colour polymorphism in the common land snail—to be in fact confirmations of his view. For modern Darwinians only trivial variations can be indifferent to selection pressure. Whatever characters are stable must have a reason, and the reason must be adaptive, otherwise natural selection could not control it.

The compelling power of the selection theory—that is, the view that all major trends in evolution are adaptive, and that the genesis of adaptations is explained by the gradual and external control of chance variations through selection pressure—is well illustrated, for example, by de Beer's reasoning in the centennial essay quoted above. Attacking those who invoke against the selection theory its "mathematical improbability," he argues that they

... can be refuted out of their own mouths. Muller has estimated that on the existing knowledge of the percentage of mutations that are beneficial, and a reasoned estimate of the number of mutations that would be necessary to convert an amoeba into a horse, based on the average magnitude of the effects of mutations, the number of mutations required on the basis of chance alone, if there were no natural selection, would be of the order of one thousand raised to the power of one million. *This impossible and meaningless figure serves to illustrate the power of natural selection in collecting favourable mutations and minimising waste of variation, for horses do exist and they have evolved.* (my italics)

In other words, if horses have evolved—and few are those who would like to deny it—and if an explanation of this transformation through random mutations alone is excessively unlikely—as indeed it seems to be, since the great majority of mutations so far observed are adverse or even lethal—then it *must* be the automatic selection, in each generation, of very slightly advantageous variants that has built up the otherwise astonishing result. But how, one may ask, do we know this? If mutation alone cannot explain the evolutionary process—the origin of life, of sentient life, of intelligent life—why is natural selection—the elimination of the worst mutations, a negative and external agency—the only conceivable alternative?

And what does this selective process really

consist in? Selection selects by definition the better adapted alternatives; yet adaptation often leads not to survival, let alone to the evolution of new forms, but to extinction. In de Beer's centennial argument, however, this fact appears as evidence against a belief in teleology or providence, not against selection. So he argues, on the very same page as the passage just quoted:

It can be shown that the more detailed the adaptation, the more "improbable" it may appear as a product of "chance," the more likely its possessor is to be doomed to extinction through inability to become adapted to changed conditions. Structures may be developed which at first benefit individuals in their competition to survive; but by continued selection such structures may become exaggerated and lead to extinction of the species. This seems to have been what happened to the Huia-bird, where mated pairs constantly remained in company together, and the beaks of the male and female reached an extraordinary disparity of size in adaptation to their very special feeding, but failed to enable the birds to obtain ordinary food when their special diet was unavailable. Excess, even of adaptation, is harmful, and the fossil record shows that the vast majority of lines of evolution have led to extinction, which is a grim comment on the alleged powers of providential guidance and purpose.

So it is; and surely, thanks largely to Darwin's influence, few educated people believe literally any more in "providential guidance and purpose" in nature. But is it not also a "grim comment" on natural selection? Yet convinced neo-Darwinians apparently see no such implication in the Huia-bird's fate.

IN SHORT, three concepts, *evolution*, in the minimal sense of "descent with modification" (no "emergence," no "higher and lower" allowed), *variation*, in the sense of Mendelian micromutation, tiny changes in the structure or arrangement of the genes, the ultimate material of heredity (no sweeping or sudden alterations allowed), and *natural selection*, the decrease in frequency of those variants that happen in each successive generation to be less well adapted than others to their particular environment: these three form a tight circle within which, in happy self-confirmation, neo-Darwinian thinking moves. To those who believe in it, this circle is an ample intellectual dwelling place, roomy enough in fact to house all the immense achievements of modern biological research. To those not so convinced, however, the circle seems a strangely constricted one. They may even agree with the Professor Emeritus of Zoology at Cambridge that "no amount of argument, or clever epigram, can disguise the inherent improbability of orthodox (Darwinian) theory."

And though such non-believers may not, as Dr. Himmelfarb suggests, include a "growing number of scientists," neither are they so few or so feeble as neo-Darwinian writers sometimes suggest.

How does this tight trio of concepts take so firm a hold upon so many and such able minds? If we are not convinced by the neo-Darwinian dogma we may well ask this question; and if we do so, Dr. Himmelfarb's book will give us important help on the road to an answer. True, she is dealing principally with 19th-century Darwinism; she brings to life not only Darwin as a scientist but also his friends and contemporaries, Lyell, Huxley, Hooker, and the climate of opinion in which their ideas originated and flourished. But to do this as clearly and painstakingly as she does is to make a significant contribution also to our understanding of the nature of Darwinism in its present form. Three points in particular stand out very clearly from her analysis.

FIRST, it is one of the major paradoxes of the history of science, that the Darwinian theory, speculative as it must be by the very nature of its subject-matter, has been held up as a model of simple Baconian induction through the patient accumulation of facts. Now no one denies that Darwin did patiently accumulate facts—but the facts he accumulated during the voyage of the *Beagle* did not at the time lead him to his species theory, and moreover, for many of the years during which the species theory was maturing in his mind he was in fact accumulating facts not directly about evolution but for his extended work on barnacles. No, the species theory, like most great forward steps in science, was a triumph of scientific *imagination* rather than of fact-collecting. Dr. Himmelfarb shows us plainly the two leaps of imagination through which Darwin's theory took shape: first in the sketch of 1837, where he speaks of *adaptation* perpetuated through *generation*, and secondly in the notes of 1842 and 1844, which follow his reading of Malthus on population, the text which by his own account suggested to him the concepts of struggle for existence and survival of the fittest, the essential agents of *natural selection*. These steps once made, the new conceptual scheme took over, and the task of the *Origin* was to amplify the evidence in its support—evidence gleaned everyhow and everywhere—with the passion of genius, but not, as Dr. Himmelfarb remarks, by unusually accurate or systematic collection of data—and to assimilate within its all-enclosing scope whatever evidence might appear at first sight to conflict with it. The method is one of imagination, of extrapolation from a few facts to many more

inferred realities seen in terms of the imagined scheme, and proof of these realities by the exclusion of other possibilities. Much the same method, Dr. Himmelfarb points out, was employed by Darwin in his work on the origin of coral reefs: the *subsidence* theory, which he held must be true of all such formations because as a conceptual scheme it was so clearly superior to the current alternative, the volcanic-crater theory. And the other alternative being excluded, this one is proved: "If, then," he writes, "the foundations of the many atolls were not uplifted into the required position, they must of necessity have subsided into it; and this at once solves every difficulty." This style of argument occurs again and again in the *Origin* also—and it is also very like Sir Gavin's argument about mutation, selection, and the horse.

This is not to suggest that Darwin or Darwinians, past or present, are "speculative" rather than "scientific" in their reasoning. Darwin himself certainly was not of a philosophical turn of mind; and he certainly believed sincerely, as his followers have done and do, that, as against such day-dreaming evolutionists as his grandfather or such systematising evolutionists as Herbert Spencer, he was patiently and empirically and critically pursuing facts and rejecting hypotheses not confirmed by facts. Yet what the genius of Darwin achieved, surely, was not to discover a host of new facts unknown to his predecessors that somehow added up to the further fact of evolution through natural selection; what he did was to see the facts in a new context—an imaginative context, the context of an idea, but an idea which seemed and seems to many modern minds peculiarly factual, an idea so convincing, so congenial, so satisfying that it feels like fact.\*

Moreover, the circular structure which seems so oddly illogical to the outsider is just what, seen from the inside, most firmly supports the theory. "The genius—and the folly—of such a theory," Dr. Himmelfarb says of the *subsidence* theory, "is that it can explain anything and everything," and she shows how this applies to

\* Mr. G. F. Seddon has written in the *Manchester Guardian* (July 17th): "It must have been at a fairly early age that I decided that Mr. Darwin had a better explanation of my existence than God. I forget whether his idea, once implanted, spread like a cancerous growth to oust the other belief, or whether it filled a vacuum left by loss of belief. However it happened, it seemed satisfyingly right, and it still does."

"Dr. Gertrude Himmelfarb in *Darwin and the Darwinian Revolution* knocks holes in his data and his logic, but even if she took the bottom out of him altogether (which she does not, nor set out to do) I should still find him satisfying even if not right."

the argument of the *Origin* as well. This, again, it seems to me, is an important point if one wants to understand the modern as well as the 19th-century evolutionary literature. Difficulties such as the want of intermediaries in the fossil record or the problem of explaining on a chance-plus-elimination basis the slow cumulative evolution of organs like the eye, Darwin overcame sometimes by adding further hypotheses to support his original hypothesis, sometimes by urging us not to let our reason give in to a mere difficulty of imagination; and his very frankness in facing these difficulties as difficulties seemed to turn them from difficulties of the theory into parts of its proof. How could this be? Dr. Himmelfarb suggests that Darwin moves between two senses of explanation: to explain and to explain away. That may be what happens in effect, but the root of the matter, I suspect, lies deeper. It was the idea of natural selection that convinced the Victorians that evolution happened: so much so that for many people the idea of evolution *means* natural selection still. Now the chief direct evidence for evolution is the fossil record, but this, with its gaps, its explosive periods, its development of structures past any apparent adaptive end, is not in the main evidence for the very gradual, adaptation-controlled process envisaged by Darwin. Yet if it is evidence for evolution, and evolution *means* natural selection, then natural selection, by its convincing power, assimilates to itself the very evidence which would seem at first glance to tell against it. Thus Darwin's argument on the one hand *proves* that evolution happened by natural selection, and on the other hand, *conceiving* evolution as the result of natural selection, identifies all evidence for evolution with evidence for selection. It is not evolution as such but evolution by selection that defines the circle. *Difficulties* of selection theory, if they are proofs of evolution, must be in fact *proofs* of selection—since that is what, essentially, evolution is.

MODERN arguments work in much the same way. Thus for example the recent work of H. B. D. Kettlewell on industrial melanism has certainly confirmed the hypothesis that natural selection takes place in nature. This is the story of the black mutant of the common peppered moth which, as Kettlewell has shown with beautiful precision, increases in numbers in the vicinity of industrial centres and decreases, being more easily exposed to predators, in rural areas. Here, say the neo-Darwinians, is natural selection, that is, evolution, actually going on. But to this we may answer: selection, yes; the colour of moths or snails or mice is clearly controlled by visibility to predators; but "evolution"? Do these observations explain how

in the first place there came to be any moths or snails or mice at all? By what right are we to extrapolate the pattern by which colour or other such superficial characters are governed to the origin of species, let alone of classes, orders, phyla of living organisms? But, say the neo-Darwinians again, natural selection is the only mechanism we observe in present-day nature. But again, if this were so, we should still have no right to say that the only mechanism we see at work now is the only one that has been at work in all the long past of the living world. Nor, for that matter, is it the only "mechanism." What of the mechanisms of development? Why not look at phylogeny as an ontogeny writ large, at the history of groups as expressing a fundamental rhythm still, in its intimacy, unknown to us, but analogous to the rhythm of individual development? Because the chance-variation/natural-selection schema, which through Darwin's work first convinced the world that evolution did in fact happen, still holds the mind entranced, absorbs into itself *all* evolutionary data, and at the same time rejects all data not so absorbable.

To say that neo-Darwinian thinking moves *within a circle of concepts is not, in itself, however, to challenge its validity.* For all comprehensive theories, all fundamental theories that the mind really dwells in—the corpuscular theory of the Newtonians, the relativity theory of 20th-century physicists—are similarly circular, since they rest in the last analysis on the self-satisfying character of their own premises. But in the case of neo-Darwinism the circle seems so narrow, and the detours taken to maintain it in the teeth of the evidence so circuitous and so many. Several years ago, for example, Professor C. H. Waddington gave a series of B.B.C. broadcasts called "Is the Problem of Evolution Solved?" in which he described some experiments that seemed at the time to shed some doubt on some aspects of the current theory; now his findings appear to have been happily assimilated and his title forgotten. He produced a character called "crossveinless" in fruit flies by subjection to high temperature for a short period of time. Breeding crossveinless flies, he got a higher proportion of flies which reacted in this way to the heat treatment; but after a time he got a race of flies that were crossveinless even *without* subjection to heat. This looked like a cousin, at least, of the geneticists' old enemy, inheritance of acquired characters. But no, genes and selection explain it all with ease. So P. M. Sheppard writes in his recent book *Natural Selection and Heredity*:

In other words, selection had resulted in a character, usually only produced under excep-

tional environmental conditions, being produced under normal conditions. Selection for those individuals that produced the character only with heat-shock would give a phenotypically flexible stock, whereas selection for those that produced it under both conditions would give a phenotypically fixed one. This result explains how some plants or animals can develop a gene-complex which produces a particular form fitted to a particular environment under most environmental conditions; that is to say, they are not phenotypically flexible, whereas in others the form is only produced under the appropriate environmental conditions (i.e. it is phenotypically flexible).

In short, the gene-complex, together with the theory of polygenic inheritance, can do anything. For each character is controlled, not, as used to be thought, by one gene, but by many genes, all balancing and buffering one another; and every change in the environment is balanced against the resulting balance. Thus in stable environments natural selection is conservative, preserving advantageous arrangements against disruption; but let the environment begin changing ever so slightly, natural selection causes—or rather *is*, by definition—the slight preponderance of a genotype slightly more favourable to the new conditions. Whatever might at first sight appear as evidence against the theory is assimilated by redefinition into the theory.

Finally, if evolution is axiomatically evolution by natural selection, it is at the same time evolution as progressive adaptation, since it is adaptive relationships that natural selection controls. This identity—the dependence of Darwinian and neo-Darwinian thought on the axiom that organic phenomena are explicable primarily in terms of adaptation, of the usefulness of particular structures and functions in particular niches in nature—is also illuminated, in its 19th-century background, by Dr. Himmelfarb's work. Firstly, as she points out, the sketch of 1837 argues plainly *from* adaptation as its basic datum. Secondly, "adaptation" is a matter of means and ends; and the reception of the *Origin* as Dr. Himmelfarb describes it shows how essential such means-end relations are to its argument. From the first the *Origin*, dispensing with a planner and with fixed ends for the processes of nature, seemed to many critics materialistic and mechanistic in its inspiration, but, saturated as it is with the conception of utility, fitness, and the like, appealed to others as the triumphant vindication of teleological thinking. For the in-between teleology of utilitarian thought is indeed the proper habitat, the natural niche, of Darwinism. Darwin, Shaw said, threw Paley's famous watch, the paradigm for the argument from design, into the ocean.

It was not really, however, the watch he threw away, but the watchmaker. Darwinism is teleology decapitated; everything in nature is explained in terms of its purpose, but an unplanned purpose in which the organism is tool, tool user, and beneficiary all in one. And the artefact analogy is as basic to Darwinism, both old and new, as it is to natural theology: not only is the concept of natural selection grounded on the analogy with the great livestock breeders, but organisms themselves are conceived in Paleyan terms as contrivances, aggregates of characters and functions good for—what? For survival, that is, for going on being good for, going on being good for—and so an *ad infinitum*. For the *summum bonum*, like the maker, is dispensed with; yet the means-end relation, the notion of "this as useful for that," is fundamental still.

MOREOVER, despite the attempt of some of the leading neo-Darwinians to prove a selection theorem independently of the fact of adaptation, in purely mathematical terms, all this, again, is equally true of neo-Darwinism. For again and again in the course of their arguments the bare mathematics has to be swelled out to its full adaptive context in order to make of it a theory of evolution—though it may be drawn in again to statistical and mathematical form as scientific respectability demands. From this point of view by far the most honest and consistent statement of Darwinism in recent years is the Pelican on evolution by Maynard Smith. He starts, for example, with an account of Dice's experiments proving that owls take more mice against a contrasting than a similar background. This is to begin fairly and squarely with the old Darwinian idea of adaptation for survival, and from here he argues ingeniously but openly to fit a wide variety of evidence into a frankly utilitarian context. He uses, and cites others who use, modern statistical methods in the service of selection theory, but he does not pretend to *deduce* the equation of evolution with adaptive relationships from a mathematical base. Both the strength and the limitations of the theory appear with much less ambiguity in this form.

For it is precisely the insistence on the equation of life with adaptation that defines the limits of Darwinism, and it is doubt of the all-inclusiveness of adaptation as a concept definitive of life that motivates the most effective objections to the Darwinian synthesis. As between the Lamarckian and neo-Darwinian views of the origin of adaptations Darwinism appears to have won out; and though many critics of Darwinism still challenge it on the ground that the infinitely complex harmonies of mutual

adaptations could not have been produced simply by a set of curious chances, the most fundamental opposition comes, it seems to me, from a more sweeping challenge. One may indeed ask whether all adaptations have arisen by Darwinian-Mendelian means; but one may also ask, as some eminent biologists do, whether evolution, on a large as well as on a small scale, is essentially a matter of adaptation at all. To such biologists—such as A. M. Dalcq of Brussels, O. Schindewolf of Tübingen, or A. Vandel of Toulouse—there appear in fact to be two divergent directions in the evolutionary story. There are, indeed, all the minute specialised divergences like those of the Galapagos finches which so fascinated Darwin; it is their story that is told in the *Origin* and elaborated by the selectionists to-day. But these are dead ends, last minutiae of development; it is not from them that the great massive novelties of evolution could have sprung. For this, such dissenters feel, is the major evolutionary theme: great new inventions, new ideas of living, which arise with startling suddenness, proliferate in a variety of directions, yet persist with fundamental constancy—as in Darwinian terms they would have no reason in the world to do. Neither the origin and persistence of great new modes of life—photosynthesis, breathing, thinking—nor all the intricate and co-ordinated changes needed to support them, are explained or even made conceivable on the Darwinian view. And if one returns to read the *Origin* with these criticisms in mind, one finds, indeed, that for all the brilliance of its hypotheses piled on hypotheses, for all the splendid simplicity of the “mechanism” by which it “explains” so many and so varied phenomena, it simply is not about the origin of species, let alone of the great orders and classes and phyla, at all. Its argument moves in a different direction altogether, in the direction of minute specialised adaptations, which lead, unless to extinction, nowhere. And the same is true of the whole immense and infinitely ingenious mountain of work by present-day Darwinians: *c'est magnifique, mais ce n'est pas la guerre!* That the colour of moths or snails or the bloom on the castor bean stem are “explained” by mutation and natural selection is very likely; but how from single-celled (and for that matter from inanimate) ancestors there came to be castor beans and moths and snails, and how from these there emerged llamas and hedgehogs and lions and apes—and men—that is a question which neo-Darwinian theory simply leaves unasked. With infinite ingenuity it elaborates the microscopic conditions for such macroscopic occurrences; but it provides no conceptual framework in terms of which they can be admitted to exist, let alone an “explana-

tion” of their descent from “lower” forms.\* In short, reflections on some of the problems of macroevolution may well lead to remarks like that of Professor Waddington, tucked away in the folds of his ingenious and “orthodox” argument on *The Strategy of the Genes*:

... the unprejudiced student is likely to derive the impression that the failure of present theory to provide any plausible explanation for such occurrences has played a not unimportant part in weighting the scales against an acceptance of their real existence. It would certainly seem that in this field . . . the adequacy of modern theory may be doubted.

Moreover, evolutionists sceptical of the neo-Darwinian synthesis have themselves empirical evidence to support their doubts. For despite the neo-Darwinians' claims, two great biological disciplines, paleontology and embryology, appear to lend their chief weight against the selectionist dogma.

**P**ALEONTOLOGY, once more, furnishes both the most direct evidence for the fact of evolution, and the most imposing evidence against the conception of evolution as a continuous, gradual progression of adaptive relationships. “Gaps in the fossil record” were a serious stumbling block in Darwin's time, and despite the discovery of many missing links—for example the striking completion of horse family history, or the discovery of the bird ancestor Archaeopteryx, with its reptilian features—they still persist. Moreover, they persist systematically: over and over, with suddenness termed “explosive,” a bewildering variety of new types appear: this is true, notably, for example, of the origin of the major mammalian types. Thus, as G. G. Simpson's calculations of rates of evolution show, the bat's wing, if evolved by “normal” Mendelian mutation and selective pressure, would have had to begin developing well before the origin of the earth!†

\* Neo-Darwinians, of course, have heard this question; they say, “natural selection plus time will do the trick.” But in what sense is this an answer? Natural selection as a mechanism observed in nature is a short-term business, and to extrapolate it to the whole of macroevolution needs great faith indeed; natural selection in the statistical sense of “differential reproduction,” on the other hand, is simply a formulaic expression for the retrospective observation that evolution *has* happened, including all its aspects, those not conforming as well as those conforming to the micro-mutation-selection theory of its nature.

† This does not, however, we should add, impair Professor Simpson's confidence in the neo-Darwinian synthesis.

Once new types appear, moreover, they frequently continue, so some paleontologists at least believe, in directions bearing no systematic relation to adaptive needs: in fact, they often exceed the demands of utility so grossly as to lead their species and genera and families to the common fate of life: that is, to death. Again, of course, if one is convinced in advance that all extinction *must* result not from any general "evolutionary trend," but from environmental change, one can interpret these cases too in accordance with selectionist principles: as T. S. Westoll has done, for instance, with the oyster ancestor *Gryphaea*, which looks as if it had secreted so much limestone that it left itself no room to live in its own shell. These over-specialised creatures, Westoll argues, were probably aged individuals of no evolutionary interest and their particular form of senility may have been associated with an actual reproductive advantage earlier in their individual lives: so that selection kept them going because of this advantage, which happened to carry with it what looks to us like a disadvantage; and in fact it may have been not this "disadvantage" but an environmental change (for which however we have no evidence) that carried them off. Thus we must infer both an unknown advantage and an unknown environmental change in order to avoid making the much more obvious inference that this kind of animal—this pattern of living—simply played itself out.

But if the major rhythms of the history of life in the past seem to some students to resist compression into the Darwinian-Mendelian mould, these stubborn paleontological data agree, on the other hand, in the opinion of a number of biologists, with the evidence provided by our knowledge of development, that is, of the his-

tory of the living individual. There has been interesting speculation during the past thirty years, and even earlier—speculation based on increasing knowledge of comparative embryology—on the rôle of "heterochrony," or change in the temporal rhythms of development, in effecting evolutionary change. Instead of being tacked on, as evolutionists used to think, to the adult stage of early forms, it looks as if new developments may occur at any stage in the life cycle—the earlier, the more basic: and, in terms

of the fossil record, the more sudden. Sometimes such early changes appear, indeed, to have consisted in a kind of inspired infantilism: the retention of a larval stage into adult life, permitting, as it were, rejuvenation of the race. This would explain the poverty of the fossil record at transitional stages, and the relatively sudden bursts of evolutionary energy that so frequently occur. The late Professor Garstang of Leeds, one of the great originators of this kind of evolutionary thinking, first published in 1894 his theory that the chordates may have developed from something like an echinoderm (starfish or sea urchin) larva: a freely swimming form, which, being dorsally exposed to light, might be stimulated to develop the dorsal nervous system characteristic of verte-

brates. Or again, it has been pointed out that a human adult holds his head like an embryo dog: presumably, the failure to grow up in this respect enabled our ancestors to adopt an upright posture, and to achieve binocular vision. A host of arguments of this kind are substantiated and systematised in de Beer's book, to which I have already referred. To biologists like Vandel or Schindewolf, however, the view of evolution they suggest does not, as de Beer thinks, complement selection theory, but runs



*Mr Darwin and Friend c. 1867*

directly counter to it. Along with the growing evidence from experimental embryology (stressed, for example, by Dalcq or by the late R. S. Lillie of Chicago), conceptions like these suggest, not that life's history is a function of two variables, variation and selection, but that it hides a much richer complexity, a spontaneity, an inventiveness, an orderliness which eludes explanation in terms of such simple conceptions, however masterly the statistical edifice on which they are enthroned. Once more, if one *must* reduce the macroscopic to the microscopic, one can indeed say, there *must* have been "rate genes" to bring these changing rhythms about: but this is, once more, to postulate an unknown to explain away an uncomfortable aspect of the known.

YET, if all this is so, why is the neo-Darwinian theory so confidently affirmed? Partly, in the centennial year, as a mark of respect for the Newton of biology; but partly also, I believe, because neo-Darwinism, like Darwinism before it, is more than a scientific theory. It is a theory deeply embedded in a scientific faith: in the faith that science can and must explain all the phenomena of nature in terms of one hypothesis, and that an hypothesis of maximum simplicity, of maximum impersonality and objectivity. Relatively speaking, neo-Darwinism is logically simple: there are just two things happening, chance variations, and the elimination of the worst ones among them; and both these happenings are just plain facts, things that *do* or *don't* happen, *yes* or *no*. Nature is like a vast computing machine set up in binary digits; no mystery there. And—what man has not yet achieved—the machine is self-programmed: it began by chance, it continues automatically, its master plan itself creeping up on itself, so to speak, by means of its own automatism. Again, *no mystery there*. Like Strauss' miracles, mystery is banished; man is at home in a simple rational world.

As against this simplistic and reductive explanation, however, this cosmic behaviourism, the objections I have mentioned, such as the need to recognise the harmony of adaptations or the persistent structures and rhythms in phylogenetic development, are complicating and hence mystifying matters. They introduce a need for a more complex logic, permitting levels of emergence, for example; they introduce a need for frank retrospective assessment of the

evolutionary story, and hence for personal appraisal of our own situation in evolution, as the outcome of evolution. Thus, in a recent paper, Professor Dalcq has warned us that, even should life be synthesised in the laboratory, it would be we ourselves, thinking and continuing products of life's long history, who had achieved this synthesis: and this fact would make an essential, logical, even a metaphysical difference to the import of the achievement.

From another perspective, David Lack, loyal Darwinian though he is, gives the game away. In the book I have already mentioned, he refers to Darwin's question: "Can the mind of man, descended, as I believe, from the lowest animal, be trusted when it draws such grand conclusions?" and he comments:

Darwin's "horrid doubt" as to whether the convictions of man's evolved mind could be trusted applies as much to abstract truth as to ethics; and "evolutionary truth" is at least as suspect as evolutionary ethics. At this point, therefore, it would seem that the armies of science are in danger of destroying their own base. For the scientist must be able to trust the conclusions of his reasoning. Hence he cannot accept the theory that man's mind was evolved wholly by natural selection if this means, as it would appear to do, that the conclusions of the mind depend ultimately on their survival value and not their truth, thus making all scientific theories, including that of natural selection, untrustworthy.

Lack concludes from this that the old opposition of science and religion is still, and must remain, an "unresolved conflict." But I think one may conclude, on the contrary, that it is the conventional logic of science, and the view of mind implied in it, that needs revision. For, as Plato argued long ago about Protagoras' "man the measure," there is surely something wrong in a theory which, at its very root, invalidates itself.

To help us to understand, and to overcome in our own minds, this heritage of simplistic scientism is a signal service of Dr. Himmelfarb's book. From the reductive, mechanistic point of view, however, from the point of view of the faith of Darwinism, all these arguments, biological as well as historical and philosophical, are muddled and mystical, unscientific, and therefore incompetent objections, lying, even when they come from competent scientists rather than historians or philosophers, beyond the bounds of rational discourse.

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## NOTES & TOPICS

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### Footnote to Mr. Crankshaw

“I JUST have a hunch,” said Roosevelt in 1943, “that Stalin doesn’t want anything but security for his country.” In the years after the war the governments of the democratic nations of Western Europe gradually came to take a different view of the aims of Soviet policy, and this was the reason for their agreement to set up the North Atlantic Treaty Organisation. Recently, however, there has been a widespread revival of the Rooseveltian hunch, and attempts have been made to tell the story of the cold war as primarily the result of a Western misunderstanding of the Kremlin’s real intentions. One of the most persuasive advocates of this school of thought is Mr. Edward Crankshaw, who has expounded it in a series of three articles published in the *Observer* on the occasion of Khrushchev’s journey to America. “Looking back,” he writes in what may fairly be taken as the key sentence of his argument,

it is easy enough to see that Stalin’s moves from 1945 to 1947 were all concerned with one overriding objective, a limited objective: the killing of the potential threat of a *revanchist* Germany which might form a coalition with other Powers hostile to the Soviet Union.

At a time when so much may depend on what view is taken by the public in Europe and America of the origins and issues of the Soviet-Western conflict of the last fourteen years, it is worth while to study this claim rather carefully.

It may, indeed, be easy for Mr. Crankshaw to believe in the truth of what he writes, looking back from a year when West Germany is a member of NATO, and has an army, which there is a question of providing with nuclear weapons. But it is not so easy to believe it if one considers the historical facts of the period to which Mr. Crankshaw refers. When the Western and Soviet armies met in the middle of Germany in the spring of 1945, they were not only victorious over their common foe, but they achieved a victory that was total. All the German armed forces became prisoners of war; all German war material fell into the hands of the victors; all the territory of Germany was occupied; the German government ceased to exist. It had already been agreed among the Allies that Germany should be demilitarised and disarmed and that her war industries should be

dismantled. What grounds then had the Soviet government in 1945, or the two years following, for thinking that Britain or the United States intended to build up Germany again as a strong military power with the capacity and will once more to attack the Soviet Union? Mr. Crankshaw, conceding that during the war the Russians kept their co-operation and contact with their allies to an unavoidable minimum, explains this as due to Stalin’s fear that Britain and America would at some stage of the war do a deal with Hitler at his expense. Given the background of past relations between the Soviet Union and the Western democracies, the memories of Munich and the Nazi-Soviet Pact, it cannot be said that such a suspicion was altogether an irrational one, even without a Marxist-Leninist conception of how imperialist governments must be expected to behave. Nevertheless, Britain and America did fight the war through to the end without making any deal either with Hitler or with German generals, and by May 1945 there was nothing left of German power with which a deal might be done.

Now surely, if Stalin’s policy was based, as Mr. Crankshaw thinks, simply on the purpose of “killing the potential threat of a *revanchist* Germany,” this was the moment to negotiate firm agreements with the Western powers to keep Germany permanently disarmed and maintain an alliance which had stood the test of four years of war. But from the outset the Russians not only made a unified Allied economic policy for Germany impossible by sealing off their own zone economically; they also challenged the Western powers politically by working for the establishment of Communist supremacy not only in their own zone, but in the Western zones as well. Having used their position as occupying power in their own zone to compel the German Social Democrats to merge with the Communists in the Socialist Unity Party (under Communist leadership), the Russians in the summer of 1946 launched a high-powered campaign of agitation in the Western zones, directed and subsidised from the Soviet zone, at a time when political parties as yet hardly existed in the Western zones, because it was the policy of the Western powers not to encourage party political activities until “de-Nazification” had been carried out. For a while the Western occupation authorities tolerated the invasion of Communist organisers from the Soviet zone, but finally they put a stop to it, and this became a major Russian grievance, although no non-Communist leaders from the West were allowed to enter the Soviet zone, and the leader of the German Social Democrats, Dr. Kurt Schumacher, who had spent eight years