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978-1-108-00132-8 - Darwinism: An Exposition of the Theory of Natural Selection,  
with some of its Applications

Alfred Russel Wallace

Excerpt

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## CHAPTER I

WHAT ARE "SPECIES," AND WHAT IS MEANT BY  
THEIR "ORIGIN"

Definition of species—Special creation—The early Transmutationists—  
Scientific opinion before Darwin—The problem before Darwin—  
The change of opinion effected by Darwin—The Darwinian theory  
—Proposed mode of treatment of the subject.

THE title of Mr. Darwin's great work is—*On the Origin of Species by means of Natural Selection and the Preservation of Favoured Races in the Struggle for Life*. In order to appreciate fully the aim and object of this work, and the change which it has effected not only in natural history but in many other sciences, it is necessary to form a clear conception of the meaning of the term "species," to know what was the general belief regarding them at the time when Mr. Darwin's book first appeared, and to understand what he meant, and what was generally meant, by discovering their "origin." It is for want of this preliminary knowledge that the majority of educated persons who are not naturalists are so ready to accept the innumerable objections, criticisms, and difficulties of its opponents as proofs that the Darwinian theory is unsound, while it also renders them unable to appreciate, or even to comprehend, the vast change which that theory has effected in the whole mass of thought and opinion on the great question of evolution.

The term "species" was thus defined by the celebrated botanist De Candolle: "A species is a collection of all the individuals which resemble each other more than they resemble anything else, which can by mutual fecundation

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produce fertile individuals, and which reproduce themselves by generation, in such a manner that we may from analogy suppose them all to have sprung from one single individual." And the zoologist Swainson gives a somewhat similar definition: "A species, in the usual acceptation of the term, is an animal which, in a state of nature, is distinguished by certain peculiarities of form, size, colour, or other circumstances, from another animal. It propagates, 'after its kind,' individuals perfectly resembling the parent; its peculiarities, therefore, are permanent."<sup>1</sup>

To illustrate these definitions we will take two common English birds, the rook (*Corvus frugilegus*) and the crow (*Corvus corone*). These are distinct *species*, because, in the first place, they always differ from each other in certain slight peculiarities of structure, form, and habits, and, in the second place, because rooks always produce rooks, and crows produce crows, and they do not interbreed. It was therefore concluded that all the rooks in the world had descended from a single pair of rooks, and the crows in like manner from a single pair of crows, while it was considered impossible that crows could have descended from rooks or *vice versâ*. The "origin" of the first pair of each kind was a mystery. Similar remarks may be applied to our two common plants, the sweet violet (*Viola odorata*) and the dog violet (*Viola canina*). These also produce their like and never produce each other or intermingle, and they were therefore each supposed to have sprung from a single individual whose "origin" was unknown. But besides the crow and the rook there are about thirty other kinds of birds in various parts of the world, all so much like our species that they receive the common name of crows; and some of them differ less from each other than does our crow from our rook. These are all *species* of the genus *Corvus*, and were therefore believed to have been always as distinct as they are now, neither more nor less, and to have each descended from one pair of ancestral crows of the same identical species, which themselves had an unknown "origin." Of violets there are more than a hundred different kinds in various parts of the world, all differing very slightly from each other and forming distinct

<sup>1</sup> *Geography and Classification of Animals*, p. 350.

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*species* of the genus *Viola*. But, as these also each produce their like and do not intermingle, it was believed that every one of them had always been as distinct from all the others as it is now, that all the individuals of each kind had descended from one ancestor, but that the “origin” of these hundred slightly differing ancestors was unknown. In the words of Sir John Herschel, quoted by Mr. Darwin, the origin of such species was “the mystery of mysteries.”

*The Early Transmutationists.*

A few great naturalists, struck by the very slight difference between many of these species, and the numerous links that exist between the most different forms of animals and plants, and also observing that a great many species do vary considerably in their forms, colours, and habits, conceived the idea that they might be all produced one from the other. The most eminent of these writers was a great French naturalist, Lamarck, who published an elaborate work, the *Philosophie Zoologique*, in which he endeavoured to prove that all animals whatever are descended from other species of animals. He attributed the change of species chiefly to the effect of changes in the conditions of life—such as climate, food, etc.—and especially to the desires and efforts of the animals themselves to improve their condition, leading to a modification of form or size in certain parts, owing to the well-known physiological law that all organs are strengthened by constant use, while they are weakened or even completely lost by disuse. The arguments of Lamarck did not, however, satisfy naturalists, and though a few adopted the view that closely allied species had descended from each other, the general belief of the educated public was, that each species was a “special creation” quite independent of all others; while the great body of naturalists equally held, that the change from one species to another by any known law or cause was impossible, and that the “origin of species” was an unsolved and probably insoluble problem. The only other important work dealing with the question was the celebrated *Vestiges of Creation*, published anonymously, but now acknowledged to have been written by the late Robert Chambers. In this work the action of general laws was traced throughout the

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universe as a system of growth and development, and it was argued that the various species of animals and plants had been produced in orderly succession from each other by the action of unknown laws of development aided by the action of external conditions. Although this work had a considerable effect in influencing public opinion as to the extreme improbability of the doctrine of the independent "special creation" of each species, it had little effect upon naturalists, because it made no attempt to grapple with the problem in detail, or to show in any single case how the allied species of a genus could have arisen, and have preserved their numerous slight and apparently purposeless differences from each other. No clue whatever was afforded to a law which should produce from any one species one or more slightly differing but yet permanently distinct species, nor was any reason given why such slight yet constant differences should exist at all.

*Scientific Opinion before Darwin.*

In order to show how little effect these writers had upon the public mind, I will quote a few passages from the writings of Sir Charles Lyell, as representing the opinions of the most advanced thinkers in the period immediately preceding that of Darwin's work. When recapitulating the facts and arguments in favour of the invariability and permanence of species, he says: "The entire variation from the original type which any given kind of change can produce may usually be effected in a brief period of time, after which no further deviation can be obtained by continuing to alter the circumstances, though ever so gradually, indefinite divergence either in the way of improvement or deterioration being prevented, and the least possible excess beyond the defined limits being fatal to the existence of the individual." In another place he maintains that "varieties of some species may differ more than other species do from each other without shaking our confidence in the reality of species." He further adduces certain facts in geology as being, in his opinion, "fatal to the theory of progressive development," and he explains the fact that there are so often distinct species in countries of similar climate and vegetation by

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“special creations” in each country; and these conclusions were arrived at after a careful study of Lamarck’s work, a full abstract of which is given in the earlier editions of the *Principles of Geology*.<sup>1</sup>

Professor Agassiz, one of the greatest naturalists of the last generation, went even further, and maintained not only that each species was specially created, but that it was created in the proportions and in the localities in which we now find it to exist. The following extract from his very instructive book on Lake Superior explains this view: “There are in animals peculiar adaptations which are characteristic of their species, and which cannot be supposed to have arisen from subordinate influences. Those which live in shoals cannot be supposed to have been created in single pairs. Those which are made to be the food of others cannot have been created in the same proportions as those which live upon them. Those which are everywhere found in innumerable specimens must have been introduced in numbers capable of maintaining their normal proportions to those which live isolated and are comparatively and constantly fewer. For we know that this harmony in the numerical proportions between animals is one of the great laws of nature. The circumstance that species occur within definite limits where no obstacles prevent their wider distribution leads to the further inference that these limits were assigned to them from the beginning, and so we should come to the final conclusion that the order which prevails throughout nature is intentional, that it is regulated by the limits marked out on the first day of creation, and that it has been maintained unchanged through ages with no other modifications than those which the higher intellectual powers of man enable him to impose on some few animals more closely connected with him.”<sup>2</sup>

These opinions of some of the most eminent and influential writers of the pre-Darwinian age seem to us, now, either altogether obsolete or positively absurd; but they nevertheless exhibit the mental condition of even the most advanced section of scientific men on the problem of the

<sup>1</sup> These expressions occur in Chapter IX. of the earlier editions (to the ninth) of the *Principles of Geology*.

<sup>2</sup> L. Agassiz, *Lake Superior*, p. 377.

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nature and origin of species. They render it clear that, notwithstanding the vast knowledge and ingenious reasoning of Lamarck, and the more general exposition of the subject by the author of the *Vestiges of Creation*, the first step had not been taken towards a satisfactory explanation of the derivation of any one species from any other. Such eminent naturalists as Geoffroy Saint Hilaire, Dean Herbert, Professor Grant, Von Buch, and some others, had expressed their belief that species arose as simple varieties, and that the species of each genus were all descended from a common ancestor; but none of them gave a clue as to the law or the method by which the change had been effected. This was still "the great mystery." As to the further question—how far this common descent could be carried; whether distinct families, such as crows and thrushes, could possibly have descended from each other; or, whether all birds, including such widely distinct types as wrens, eagles, ostriches, and ducks, could all be the modified descendants of a common ancestor; or, still further, whether mammalia, birds, reptiles, and fishes, could all have had a common origin;—these questions had hardly come up for discussion at all, for it was felt that, while the very first step along the road of "transmutation of species" (as it was then called) had not been made, it was quite useless to speculate as to how far it might be possible to travel in the same direction, or where the road would ultimately lead to.

*The Problem before Darwin.*

It is clear, then, that what was understood by the "origin" or the "transmutation" of species before Darwin's work appeared, was the comparatively simple question whether the allied species of each genus had or had not been derived from one another and, remotely, from some common ancestor, by the ordinary method of reproduction and by means of laws and conditions still in action and capable of being thoroughly investigated. If any naturalist had been asked at that day whether, supposing it to be clearly shown that all the different species of each genus had been derived from some one ancestral species, and that a full and complete explanation were to be given of how each minute difference in form, colour, or structure might have originated, and how the

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several peculiarities of habit and of geographical distribution might have been brought about—whether, if this were done, the “origin of species” would be discovered, the great mystery solved, he would undoubtedly have replied in the affirmative. He would probably have added that he never expected any such marvellous discovery to be made in his lifetime. But so much as this assuredly Mr. Darwin has done, not only in the opinion of his disciples and admirers, but by the admissions of those who doubt the completeness of his explanations. For almost all their objections and difficulties apply to those larger differences which separate genera, families, and orders from each other, not to those which separate one species from the species to which it is most nearly allied, and from the remaining species of the same genus. They adduce such difficulties as the first development of the eye, or of the milk-producing glands of the mammalia; the wonderful instincts of bees and of ants; the complex arrangements for the fertilisation of orchids, and numerous other points of structure or habit, as not being satisfactorily explained. But it is evident that these peculiarities had their origin at a very remote period of the earth’s history, and no theory, however complete, can do more than afford a probable conjecture as to how they were produced. Our ignorance of the state of the earth’s surface and of the conditions of life at those remote periods is very great; thousands of animals and plants must have existed of which we have no record; while we are usually without any information as to the habits and general life-history even of those of which we possess some fragmentary remains; so that the truest and most complete theory would not enable us to solve *all* the difficult problems which the whole course of the development of life upon our globe presents to us.

What we may expect a true theory to do is to enable us to comprehend and follow out in some detail those changes in the form, structure, and relations of animals and plants which are effected in short periods of time, geologically speaking, and which are now going on around us. We may expect it to explain satisfactorily most of the lesser and superficial differences which distinguish one species from another. We may expect it to throw light on the mutual relations of the



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animals and plants which live together in any one country, and to give some rational account of the phenomena presented by their distribution in different parts of the world. And, lastly, we may expect it to explain many difficulties and to harmonise many incongruities in the excessively complex affinities and relations of living things. All this the Darwinian theory undoubtedly does. It shows us how, by means of some of the most universal and ever-acting laws in nature, new species are necessarily produced, while the old species become extinct; and it enables us to understand how the continuous action of these laws during the long periods with which geology makes us acquainted is calculated to bring about those greater differences presented by the distinct genera, families, and orders into which all living things are classified by naturalists. The differences which these present are all of the same *nature* as those presented by the species of many large genera, but much greater in *amount*; and they can all be explained by the action of the same general laws and by the extinction of a larger or smaller number of intermediate species. Whether the distinctions between the higher groups termed Classes and Sub-kingdoms may be accounted for in the same way is a much more difficult question. The differences which separate the mammals, birds, reptiles, and fishes from each other, though vast, yet seem of the same nature as those which distinguish a mouse from an elephant or a swallow from a goose. But the vertebrate animals, the mollusca, and the insects, are so radically distinct in their whole organisation and in the very plan of their structure, that objectors may not unreasonably doubt whether they can all have been derived from a common ancestor by means of the very same laws as have sufficed for the differentiation of the various species of birds or of reptiles.

*The Change of Opinion effected by Darwin.*

The point I wish especially to urge is this. Before Darwin's work appeared, the great majority of naturalists, and almost without exception the whole literary and scientific world, held firmly to the belief that *species* were realities, and had not been derived from other species by any process accessible to us; the different species of crow and of violet



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were believed to have been always as distinct and separate as they are now, and to have originated by some totally unknown process so far removed from ordinary reproduction that it was usually spoken of as “special creation.” There was, then, no question of the origin of families, orders, and classes, because the very first step of all, the “origin of species,” was believed to be an insoluble problem. But now this is all changed. The whole scientific and literary world, even the whole educated public, accepts, as a matter of common knowledge, the origin of species from other allied species by the ordinary process of natural birth. The idea of special creation or any altogether exceptional mode of production is absolutely extinct! Yet more: this is held also to apply to many higher groups as well as to the species of a genus, and not even Mr. Darwin’s severest critics venture to suggest that the primeval bird, reptile, or fish must have been “specially created.” And this vast, this totally unprecedented change in public opinion has been the result of the work of one man, and was brought about in the short space of twenty years! This is the answer to those who continue to maintain that the “origin of species” is not yet discovered; that there are still doubts and difficulties; that there are divergencies of structure so great that we cannot understand how they had their beginning. We may admit all this, just as we may admit that there are enormous difficulties in the way of a complete comprehension of the origin and nature of all the parts of the solar system and of the stellar universe. But we claim for Darwin that he is the Newton of natural history, and that, just so surely as that the discovery and demonstration by Newton of the law of gravitation established order in place of chaos and laid a sure foundation for all future study of the starry heavens, so surely has Darwin, by his discovery of the law of natural selection and his demonstration of the great principle of the preservation of useful variations in the struggle for life, not only thrown a flood of light on the process of development of the whole organic world, but also established a firm foundation for all future study of nature.

In order to show the view Darwin took of his own work, and what it was that he alone claimed to have done, the concluding passage of the introduction to the *Origin of*

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*Species* should be carefully considered. It is as follows: "Although much remains obscure, and will long remain obscure, I can entertain no doubt, after the most deliberate and dispassionate judgment of which I am capable, that the view which most naturalists until recently entertained and which I formerly entertained—namely, that each species has been independently created—is erroneous. I am fully convinced that species are not immutable; but that those belonging to what are called the same genera are lineal descendants of some other and generally extinct species, in the same manner as the acknowledged varieties of any one species are the descendants of that species. Furthermore, I am convinced that Natural Selection has been the most important, but not the exclusive, means of modification."

It should be especially noted that all which is here claimed is now almost universally admitted, while the criticisms of Darwin's works refer almost exclusively to those numerous questions which, as he himself says, "will long remain obscure."

*The Darwinian Theory.*

As it will be necessary, in the following chapters, to set forth a considerable body of facts in almost every department of natural history, in order to establish the fundamental propositions on which the theory of natural selection rests, I propose to give a preliminary statement of what the theory really is, in order that the reader may better appreciate the necessity for discussing so many details, and may thus feel a more enlightened interest in them. Many of the facts to be adduced are so novel and so curious that they are sure to be appreciated by every one who takes an interest in nature, but unless the need of them is clearly seen it may be thought that time is being wasted on mere curious details and strange facts which have little bearing on the question at issue.

The theory of natural selection rests on two main classes of facts which apply to all organised beings without exception, and which thus take rank as fundamental principles or laws. The first is, the power of rapid multiplication in a geometrical progression; the second, that the offspring always vary slightly from the parents, though generally very closely resembling