Darwin and Natural Selection

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It is now my responsible and rather difficult task to tell in twenty minutes something of what the biological sciences and the world in general owe to Darwin, and more particularly of his brilliant work and deductions with reference to natural selection.

To the man in the street, I suppose, Darwin was the nasty old man who said that we have all descended from monkeys. I need hardly say that this is a caricature of the situation.

Charles Darwin would unanimously be acclaimed by biologists as the greatest naturalist of last century, and probably of all time. The zoologists and botanists of his day and of the centuries which preceded him were, for the most part, satisfied to observe and describe living organisms and give them a name. Darwin probably excelled them all in the powers of observation and exact description, but was not satisfied to stop there. He had a greater urge, and a greater capacity, than any of his contemporaries or predecessors to interpret nature—to answer the questions " Why ? " and " Whence ? " and " How have this and that living creature come to be as they are ? " He thereby opened up much the most fascinating field of biological research.

Before we can grasp the significance of natural selection, it is necessary to understand three sets of phenomena which were ever present in Darwin's mind, and were essential preliminaries to his main deductions, *viz.* the " web of life ", the " struggle for existence ", and the occurrence of variation within the species.

As the late Professor J. Arthur Thomson puts it, " Nature has a woven pattern which science seeks to read ". Darwin gave the world a more intimate and vivid picture than it had ever had before of this " web of life "—the inter-relationship of one living organism with another and their repercussions throughout a whole series. If there is an orchid in Madagascar with a spur eleven inches long, Darwin prophesies that there is a moth with a proboscis of equal length, and the moth is duly found. To come nearer home, what changes and repercussions have taken place in the fauna and flora of Australia through the introduction of the rabbit, the sparrow, the prickly pear, and even the domestic sheep and through the destruction of the forest covering !

But perhaps I can best illustrate the meaning of the " web of life " by two specific instances. The first is the result of Darwin's own observations, *viz.* that the red clover seed in England may be affected by the number of cats in the neighbourhood ; and it comes about in this way. Before red clover will set seed under English conditions, it is necessary that the flowers be visited by humble bees, carrying the pollen from other flowers. The chief enemies of the humble bees are the field mice, which destroy their combs and nests ; and the numbers of mice are largely affected by their natural enemies the cats. (I think it was Huxley who suggested that he

[1] A lecture delivered at the University, being one of four to commemorate the visit of Darwin to Australia in 1836.

might, perhaps, have gone a step further and said that the number of cats depended on the number of old maids in the district.) The second is this, and I use it to illustrate the dangers attending the upsetting of the " balance of nature ". They were very much troubled with rats in the island of Jamaica, and so they introduced the mongoose, and the rats were soon checked. But the mongooses (or mongeese, whichever is the correct plural) then turned their attention to poultry and wild birds of various kinds. As this went on, the injurious insects and ticks that the birds used to eat began to multiply ; and rumour has it that the ticks are now making matters very unpleasant for the mongooses.

The second preliminary is the " struggle for existence ". Darwin did not originate this idea, which is at least as old as Aristotle, and Tennyson had written of " Nature red in tooth and claw " and again " Of fifty seeds she often brings but one to bear " before the " Origin of Species " was published. But no one before Darwin realised or understood anything like the full significance of that struggle. He recognised at least three distinct forms : the struggle between the members of the same species, or closely-allied species, which were competitors for food or light, or even space ; the struggle between enemies like the stoat and the rabbit, the mongoose and the snake ; and the struggle against natural disadvantages like drought and cold.

It was the first of these that Darwin emphasised most strongly—the struggle between fellows—as, for instance, thickly sown seedlings of the same kind competing for room, moisture, food and light, or rabbits for the same scanty food supply of a particular neighbourhood. Many plants and animals are so productive of offspring that, if all the possible progeny survived, one species would soon reach alarming proportions. A common British weed (Sisymbrium) often has three-quarters of a million seeds. If all grew to maturity for only three years, the whole land surface of the globe would not hold them. The progeny of a single bacterium (which is so small that you could pack a thousand millions of them into a space little bigger than an average pin head) would, at the maximum rate of multiplication, fill up all the oceans of the globe in less than a week. Huxley calculated that if the possible descendants of a single aphis (green fly) all survived, they would, at the end of a single season, weigh down the population of China. If all the progeny of one oyster survived and multiplied, its great-great-grandchildren would provide a heap of shells eight times the size of the earth.

These are, perhaps, extreme cases, but as the numbers of each of these organisms keep relatively constant, they indicate what a large percentage of nature's progeny fail to survive in the perpetual struggle.

The third preliminary to an understanding of natural selection was, at first cautiously, and later strongly and vividly, presented by Darwin, namely the idea of variability within the species. There had, of course, been scientists who appreciated that fact of nature before Darwin's time, but they either had not the idea very clearly in their own minds, or they failed to convince others. The current belief was, of course, that species were absolutely fixed, and any other idea was regarded as rank heresy. Darwin did not publish his " Origin of Species " till 1859, but as early as 1844 he wrote to Hooker, " I am almost convinced (it is like confessing a murder) that species are not immutable ". The idea seems to have dawned in his mind while

on the *Beagle* expedition, when he found recent fossils in the Argentine which were very similar to living forms, and yet different. He was naturally also impressed by the changes which had taken place under man's influence in cultivated plants and domesticated animals. In that connection it is interesting to speculate on the controversies which might have taken place amongst biologists regarding the number of species (and genera, perhaps) to be made of various breeds of the domestic fowl or pigeon, if they had known nothing of their origin or history, and yet each group is probably derived from one species. Darwin recognised two distinct types of variation, namely those which were sudden and abrupt like the copper beech or the weeping willow (later called mutations), and what he describes as " numerous, successive, slight, favourable variations ". He attached much greater importance to the latter than to the former, as he regarded them as of much more frequent occurrence and more likely to be perpetuated.

Darwin, then, had a wide knowledge of zoology, botany and geology (including palæontology). He had a vivid impression of the " web of life " and the " struggle for existence " and a growing conviction of the occurrence of variation within the species. Looking back it would not seem a very difficult step to his central idea of the evolution of new varieties and new species through the medium of natural selection ; and we can well understand Huxley's remark, when he heard the theory for the first time : " How extremely stupid not to have thought of that."

Let me remind you of the essence of the theory in Darwin's own words : " As many more individuals of each species are born than can possibly survive, and as consequently there is a frequently recurring struggle for existence, it follows that any being, if it vary however slightly in any manner profitable to itself, under the complex and sometimes varying conditions of life, will have a better chance of surviving, and thus be naturally selected. From the strong principle of inheritance, any selected variety will tend to propagate its new and modified form."

Natural selection is thus nature's process of sifting the fittest for parenthood by the elimination of the relatively less fit to the particular conditions in the web of life. It will be seen at once that it is a long-time process, and therefore not capable of exact experimental proof. But Darwin, from his extraordinarily wide range of knowledge of living organisms, was able to produce such a wealth of evidence of how natural selection might have been supposed to operate, that he soon brought the whole scientific world round to his views. It is only fair to say that the idea of natural selection, or the survival of the fittest, as a key to evolution occurred simultaneously to another great naturalist—Alfred Russell Wallace—as he lay on a fever-stricken bed in the Moluccas, and the first definite announcement of the theory to the scientific world was in the form of a joint paper to the Linnean Society in London in 1858.

Examples of the natural selection process could be multiplied, but I shall mention only two that are fairly typical. In Dublin Bay there is a sandy island about 120 years old. It is frequented by a light-coloured variety of mouse which burrows in the sand. It seems reasonable to interpret the presence of this sand-coloured variety as due to the elimination of the more easily observed darker mice by birds of prey.

The other is an actual illustration used by Wallace : " The giraffe did not acquire its long neck by desiring to reach the foliage of more lofty shrubs and constantly stretching its neck for the purpose, but because any individuals with a longer neck

than usual secured a fresh range of pasture over the same ground as their shorter-necked companions, and on the first scarcity of food were thereby enabled to outlive them." Natural selection, acting over thousands of generations, offers a reasonable explanation of the speed of the hare, the quills of the porcupine, colour protection, mimicry and other examples of " adaptation to environment ".

It has been vaguely realised from the days of the ancient Greek philosophers that some kind of evolution had been going on in nature. Darwin gave to the world the first successful vindication of the evolution idea, and the first reasonable explanation of the chief contributing factor. The central idea of evolution, of course, is that the present is the child of the past and the parent of the future—that the plants and animals around us are the descendants of ancestors on the whole somewhat simpler, that these are descended from yet simpler forms and so on backwards, " till we lose our clue in the unknown but momentous events of pre-Cambrian ages ".

" It is ", as the late Professor J. Arthur Thomson tersely puts it, " a simple but eloquent fact that the geological record in the fossil-bearing rocks shows the gradual appearance of higher and higher forms. At a certain stage in the history of the earth all the animals were invertebrates, then fishes appeared, then amphibians, then reptiles, then birds and mammals. As the ages have passed life has been slowly creeping upwards."

Darwin was greatly impressed by the similar structure in the flipper of the seal, the wing of the bat, the foot of the dog and the hand of man, and this is his comment : " How simply explained on the principle of the natural selection of successive slight variations in the diverging descendants from a single progenitor."

There is strong confirmation, too, in the occurrence all down the line of rudimentary or vestigial organs—the dwindling remains of structures belonging to ancestral forms—analogous to the unsounded letters in many words such as the " b " in doubt and the " g " in reign, which are functionless, but tell something of the history of the words.

The doctrine of natural selection has, of course, its limitations. It does not account for the origin of life, but assumes simple living creatures with which to start the story of evolution, and it does not explain very satisfactorily the " big lifts " in the process of evolution. It is true that some of Darwin's minor ideas have had to be modified, and some have received a fuller explanation in the light of subsequent researches, especially those of Mendel and the multitude of workers which the re-discovery of his papers at the beginning of the century have brought into this fascinating field, but speaking generally, his main thesis has stood the test of three-quarters of a century of investigation and criticism.

He not only put the subject of biology on a new footing and clarified principles which have been of great value to the breeders of plants and animals, but he made the evolution idea current coin of the intellectual realm, thereby having the profoundest effect on nearly every sphere of human thought and activity—history, economics, government, linguistics, education, psychology, ethics and even religion.

For does not the evolution idea mean, amongst other things, that the scientist who patiently unravels nature's secrets and uses them for the benefit of mankind is in a very real sense " in tune with the infinite " ?