On the Origin of Species

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Darwin personally represents the idea of evolution more than any other Naturalist, although he was not the one who suggested it. That had already been done even before his birth, and a plausible mechanism had been proposed by the French Lamarque back in 1800. Lamarck's dictum of acquired characteristics are now ridiculed having been supplemented by Darwin's Natural selection, but of course this is a very unfair appraisal of a great naturalist. Yet there is no one who have argued more forcefully for evolution than Darwin through his systematic amassment of evidence as well as providing a compelling mechanism that drives it.

The organic world presents a confusing profusion of widely variable forms. Naturalists have since time immemorial tried to make some order in it, by various natural classification schemes. The basis for it is the notion of a species. The classical assumption is that species are immutable and somehow created at the same time. The spontaneous appearance of species is a problem. Do their members occur full fledged as Pallas Athena out of the brow of Zeus, or do they appear as infants or even embryos, but then how are they initially taken care of? The logical solution to this quandary is to assume that they all stem from the beginning of time. It is hardly necessary to point out that this view accords quite well with the Biblical creation myth.

But in any natural, as opposed to formal, classification of the organic world, there is implicit the idea of an evolution. Because there is a hierarchy in the classification, species are included in higher orders, which in their turn are including in families, and orders, and phyla, or whatever those progressively higher-levels are called. The basis for such classification is the idea of homology, which implies a certain degree of relatedness amongst different species. Looking at a dog, it is not at all hard to point out what are its eyes, its nose, its arms and legs; while such a task is still possible for an insect, there are now many organs which no longer are homologous to men, such as antennas, number of limbs, hairiness. The notion of similarity enters, but that is a rather subjective notion, and one can easily be led astray to conclude that whales should be classified along with sharks as fishes. Lamarck pointed out that one should make a distinction between true homologies and apparent analogies, the latter only indicating a convergent adaptation to similar niches, while the former is a valid indication of common descent. Darwin points out that what one should be looking for are organs whose roles are rather marginal in the species and hence tend to show less variability than those upon which Natural selection has seized, especially valuable for such purposes are rudimentary organs. Naturalists have instinctively been following such precepts without necessarily drawing the inevitable conclusions. An expert, contemporary with Darwin was Robert Owen, who although later becoming an opponent to Darwin, certainly did not deny evolution as such, but was able long before it became fashionable, to point out the similarity between birds and dinosaurs. Evolution provides the ultimate *sina qua non* for classification, and changes it from being an activity

ultimately based on taste and convention to one with an objective content. There is in fact a tree of life, in which every organism that has ever existed is linked with all the others. To explicitly exhibit it, is of course beyond any practical ambition, but its mere existence makes the questions as what species are descended from others, objectively meaningful. As a consequence of this, the very notion of species dissolves. The concept of species means that we can partition organism in equivalence classes bases on descent (which is incidentally neither reflexive, symmetric nor transitive, but generates a relation which is) and this is patently impossible, as any two organism will have a common parent. However, given extant organism, they tend to come in discrete units, so called species, and do not tend to blend into each other. Darwin explains this by the speciation process, meaning that intermediate variations tend to be less populous than main variations and hence more likely to become extinct. Still there are some continuous variations, examples of which manifest monodromy around the pole[1].

Why is not the earth crammed with organisms? Populations should follow geometric expansions, as on the average any pair reproduces beyond their own modest number. Darwin was very much influenced by Malthus and concluded that in nature there has to be a fierce struggle for survival, or more precisely reproduction, the former being a prerequisite for the latter. In analogy with domestic breeding, when domesticated animals are selected either consciously for specific traits or unconsciously being retained for usefulness, nature itself makes a choice by retaining only those which survive. A tautological selection if any, but nevertheless a *bona fide* selection, the more attractive, because no separate mechanism for selection has to be proposed, but is automatic. This selection is slow and it works because populations manifest variations, the source of which is a mystery to Darwin. He notes though that large populations will display a larger range of variations, and hence present more material upon which Natural selection can work. The basic principles of selection is that it makes no jumps - *Natura non facit saltum*, the progeny of parents are always very close to the parents themselves. The dramatic effects are due to accumulation sustained under very long periods.

Darwin was well aware of the uniformitarianism principles enunciated for geology by Charles Lyell. Those explained geological changes by mechanisms that were still at work today, and thus implied huge time periods. Those were crucial to Darwin's conception of evolution. The principles of evolution were still working today and they were accumulative and very slow. The direct evidence of evolution are missing, one may not exhibit the gradual variations that link one species to another, but that was due to the imperfection of the geological record. Fossilization is a rare event, and many of the fossils are simply destroyed through the necessary erosion that allows sedimentations to form, besides only a tiny fraction of the geological record has been unearthed and studied. The latter has to some extent been rectified since the time of Darwin, resulting in a far richer collection of remains, which among other things have given tantalizing glimpses of hominid lineages. Still the basic incompleteness of the record will remain forever, thus, as we have already noted, making a complete display of the tree of life impractical.

[1] There is a populations of tarns circumscribing the poles, as you go eastwards adjacent populations are mutually fertile, but once you have orbited the pole once, there will be a jump and no mutual exchange is possible.

Darwin is very vague about the principles of inheritance, as well as the source of variability. In many passages he does refer to the possibility of acquired characteristics, but at one point goes explicitly against Lamarck, when he points out that the great diversity of sterile workers in ant colonies, and whatever traits they have acquired, they are unable to transmit them to any descendants. However, he is very clear about some organisms being more advanced than others, although he gives examples of life-cycles in which the adult forms may be simpler than the preparatory and intermediate. When there is fierce competition, the victorious organisms, will be stronger than those that come out of a less competitive environment. Large populations will provide a tougher competition than smaller, hence when populations migrate, there is no symmetry, but dominant species coming from a more exacting background will tend to take over. Thus plants and animals that have migrated to the southern hemisphere from the north will tend to replace native endemic faunas and floras. In particular European mammals are superior to Australian marsupials. And faunas and floras of isolated islands are particularly vulnerable to invasions.

The geographical distribution of organisms is of particular interest to Darwin, maybe not surprising considering his rite of passage on the Beagle. The fact that very similar species are to be found among isolated mountain areas may be seen as a mystery. How come, when there is no possibility of migration between the areas? Could this be a case for specific creation? Darwin refers to previous glacial periods, which had become known in the early 19th century, which provided large connected areas of subarctic character that allowed free intermingling. When the climate than became progressively milder, the subarctic region shrank and became disconnected. Thus the geographical distribution of organisms gives clues to past climate changes. Furthermore the faunas and floras on isolated islands show close resemblance to the closest continents In some cases such as Antarctica, the closest continent is now basically devoid of life, and thus cannot provide an obvious link between the organisms of New Zealand and Patagonia. Clearly migration is more predominant from closer quarters than distant. It is also noteworthy that mammals, with the exception of the winged bats, are absent from islands far away from the continents, while seeds and birds are far more likely to make the transit. Birds on islands also tend to be bigger and flightless, the former probably a consequence of the latter. Due to the absence of mammalian predators the ability of flight is not as essential. When in recent centuries those paradises have been visited and invaded by humans and their pets, those flightless creatures have come to grief. All such things would be hard to explain by the theory of individual creation of species, as Darwin returns to over and over again.

To explain adaptational changes is a tricky business. The beetles of Madeira have lost their wings, supposedly otherwise they would have been flown to the sea by the strong prevailing winds on the islands. On the other hand, by the very same fact, the butterflies have developed larger wings to deal with that contingency. Then there are various types of selection. The most serious one works on the level of life and death, others are more directed towards reproduction, and Darwin introduces the idea of sexual selection, which often works against the survival of species, as traits are developed, often in extremis, which are detrimental to the fitness of the individual, but which serves the purpose of attracting sexual partners. Also organisms are connected to a large extent and in particular organisms

can be selected in tandem, as in the case of flowers and insects, the former attracting the latter with rewards to be reaped for the reproductive success of the flowering plants, the extreme cases being displayed by the orchids, a relative newcomer in evolution. Thus organisms are not to rely entirely on their own as to their survival, but are often dependent upon the survival of other organisms. Hence they may effect changes that enhance the survival potential of other organisms, although no organism can suffer changes to benefit other organisms unless there is a pay-off for themselves. In that sense there enters a notion of economy in evolution, and it is hardly surprising that there has developed a rather close resemblance between evolutionary models and economic ones.

Darwin's ideas were to prevail, They made a stir when they were first introduced to a wider public, but their eventual and definitive consolidation had to wait for the big evolutionary synthesis of the 1920's spearheaded by the grandson of Darwin's bulldog T.H.Huxley, namely Julian Huxley.

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