

## Lamarck and Darwin revisited

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“That little word 'why' has run through all universe from the first day of creation, and all nature cries every minute to its creator 'why'. And for seven thousand years it has had no answer”, exclaimed Captain Lebyadkin, one of the characters of the novel *Demons*, written by Fyodor Dostoyevsky (1821-1881). The principal protagonists of Western rationalism during the Scientific Revolution of the 17<sup>th</sup> century, founders of modern science, had the answer: the world was a machine like a great clock set in motion by a divine force and operating according to natural law.

The physicist Isaac Newton (1643-1727) explained it in his famous book *Philosophiae Naturalis Principia Mathematica*: “Blind metaphysical necessity, which is certainly the same always and everywhere, could produce no variety of things. All that diversity of natural things which we find suited to different times and places could arise from nothing but the ideas and will of a Being, necessarily existing.” For Newton and his followers religious beliefs predicted a rational order beneath the apparent chaos in nature. For them the truth disclosed by science may have been identified with God thoughts, which humans, as rational beings, have been successively unravelling and shared with God.

Did these members of the privileged intellectual elite not notice the misery and suffering of the common people that were coping with the drudgeries of living, striving to survive and preserve their progeny? The philosopher and mathematician Gottfried Leibniz (1646-1716), who invented calculus independently of Newton, proposed a principle of pre-established harmony to account for apparent causality in the world. Good and evil intertwined to make the actual world the best of all possible worlds. Leibniz even dreamed of a universal calculus that could map all ideas into symbols, proved his fundamental principle and eventually settle all scholarly disagreement by calculation.

Most of the thinkers in the ensuing 18<sup>th</sup> century, the “Age of Enlightenment”, conceived the world in the same way. For them, evil had no substantive nature – similarly as for the philosopher Augustine of Hippo (354-430) 14 centuries ago. Just as light is an existing thing, but darkness is non-existent, evil, like darkness, does not truly exist – it means only the absence of good. Darkness appears only when sources of light are obscured or extinguished. The enlighteners believed that once the light of knowledge penetrates the darkness of ignorance and superstition, all human beings will see things as they are. A majority of them may have been theists (or rather deists, who claimed that God exists as an uncaused First Cause that created the universe and gave humans the ability to reason, but does not intervene anymore in the created world). Some may have been agnostics or atheists, but they also may have shared the creed of the philosopher Nicolas de Condorcet (1743–1794) that, thanks to human reason, the perfectibility of humans was unlimited.

The philosopher Immanuel Kant (1724-1804) extolled the Enlightenment as the age of “man’s leaving his self-caused immaturity”. Kant attempted to generalize Newton’s theory of gravitation and applied it to the evolution of the cosmos. He considered the human reason to be powerful, but also confined in its judgments; he realized that we face difficulties if we want to understand life. An organism has a natural purpose, it is “both cause and effect of itself”. He wrote that “it would be absurd for humans to hope that there may yet arise a Newton who could make comprehensible even the generation of a blade of grass according to natural laws which no intention has ordered”. He admitted the possibility of natural evolution

of higher living species out of the lower ones, but not that the lower species could develop out of unorganized matter. He inferred that the idea of nature as purposively directed towards the existence of rational beings submitted to moral laws has allowed us to conceive God as author of nature and creator of life.

Although Kant was not able to propose a general theory of organic evolution, such a theory was put forward by Jean Baptiste Lamarck (1744-1829) and published in 1809 in his book *Philosophie Zoologique*. According to Lamarck, all life is organized in a vertical hierarchy, simple organisms are spontaneously generated from inanimate matter and, by using a material life force, continually evolve into more complex organisms. This intrinsic complexifying tendency is reinforced by an adaptive force that causes animals to adapt to local environments: the environment creates needs to which organisms respond by using some features, which are accentuated or attenuated through use and disuse. The idea is commonly illustrated in textbooks by an example of giraffes stretching their necks to reach leaves high in trees, which would thus strengthen and gradually lengthen their necks. In the same way, Lamarck argued, a blacksmith, through his work, strengthens the muscles in his arms. The characteristics that an individual organism acquired through use or disuse during its lifetime are then passed to its offspring. In Lamarck's view this is a mechanism of the gradual transmutation of species.

Lamarck had broad knowledge of plants and animals and was a practising naturalist but has not derived his theory from observation of nature. As biologist Hans Driesch wrote "Lamarck's theory of descent is purely fictitious construction and no proof is offered" [1]. Lamarck's work fit well in the boom of the classical Western rationalism. There is no wonder that he referred to God as the "sublime author of nature" – just in line with deism of his scholarly contemporaries.

In the first half of the 19<sup>th</sup> century, several other scholars pondered over evolution of life. But only two of them, Alfred Russell Wallace and Charles Darwin, got the idea that natural selection might be involved in the process. Darwin published his comprehensive theory in 1859 in a book entitled *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. The conception of the world, pictured by Darwin, was completely different from that of the classical rationalism. No rational designer was present at the beginning; the default state of the world is the struggle of entities for scarce resources that condition their stability (or, to put it in a different term, their onticity). Whatever increases a change of an entity to survive, represents "good" for it, and whatever endangers it, is "bad". In contrast to the view of classical rationalism Darwin presents us the Ontology of Evil. Those living beings that fit less to the environment, perish, the fittest ones survive – reason gains: but this reason comes *post factum*, it is a phenomenon *a posteriori*.

In contrast to Lamarck, Darwin and Wallace were empiricists and based their arguments on observations. Lamarck did not recognize the merits of Lavoisier in developing modern chemistry and supported his material life force by evoking obsolete concepts of alchemists. We should keep in mind that there was Wallace himself, who modestly proposed, in his book carrying „Darwinism“ in its title and issued in 1889, to call "Darwinism" the theory of evolution by natural selection, although he was an independent co-discoverer of it. Darwin painstakingly supported his arguments by data from other disciplines of science. But two important discoveries were not available to him in 1859. Physicist Rudolf Clausius formulated the second law of thermodynamics in 1867 and the fundamental implications of the law for biology have become elucidated only a century later. Naturalist Gregor Mendel published his results on heredity in 1866, but biologists became aware of their importance only in 1900. Not knowing Mendel's work, Darwin published his own theory of heredity in 1868, calling it pangenesis. He proposed that each part of the body continually emitted its own type of small

organic particles called gemmules that aggregated in the gonads, contributing heritable information to the gametes. Darwin thought that environmental effects that caused altered characteristics would lead to altered gemmules and they would then be transferred to offspring. Thus, pangenesis theory allowed for the Lamarckian idea of transmission of characteristics acquired through use and disuse.

In our time, the word “Lamarckism” is used as an acronym /short cut term?/ for the inheritance of acquired characteristics. Accordingly, Charles Darwin himself may be classified as a Lamarckian. Yet, Darwin’s theory of evolution underwent an evolution up to the neo-Darwinian synthesis which denied that acquired characteristics could be inherited. Upon the triumph of Neo-Darwinism in the course of the 20<sup>th</sup> century, Lamarck and his ideas were being ridiculed and discredited. Lamarck became considered to be not just wrong but absurd and even dangerous. Curiously, around the turn of the 21<sup>st</sup> century and up to our time, some scientists attempt to resuscitate Lamarck’s idea referring to the phenomenon of epigenetic inheritance. The issue is the matter of controversial debates.

It concerns of what biologist John Maynard Smith has named the dual inheritance system [2]: the familiar system, depending on DNA sequence, used in transmitting information vertically between generations, and an epigenetic inheritance system, or cellular inheritance, depending on gene activation, responsible for the horizontal transmission of states of differentiation during development of a particular organism. Even though all somatic cells of a multicellular organism have the same genome, different cell types have different RNAs and proteomes and, eventually, different functions. Cellular inheritance has been attributed mainly to methylation of DNA, histone modifications and long-lived noncoding RNA molecules, which collectively are called the „epigenome“. From time to time, epigenetic changes are transmitted vertically in sexual reproduction and have been called intergeneration epigenetic heredity. Some investigators have seen in it an adaptive role for the environment and, Eva Jablonka and Marion J. Lamb gave their 1998 book the title *Epigenetic Inheritance and Evolution. The Lamarckian Dimension*. This has been taken by many with scepticism, and for instance Brian Hall criticized it [3] by referring to Maynard Smith’s argument that environmentally-induced changes tend to reduce, not enhance fitness, and the flexibility required in epigenetic systems is at odds with the accurate replication required of genetic inheritance.

The signals from the external environment function in the same way as embryonic inductors, selectively activating the genome. A genome represents the phylogenetic memory, which has been established in evolution of a species by accumulating knowledge selected for millions of generations from random genetic variations blind to environmental cues. Maintaining high stability of the phylogenetic memory is a costly business: energy-dependent repair mechanisms enable the error rate as low as 1 in  $10^{10}$  base pairs in DNA sequence, which is incredibly accurate. On the other hand, the error rate of methylation of DNA in the epigenetic marking, which apparently dispenses with repair correction, is as high as  $10^{-1}$  per site [4]. We can tentatively assume that the occasional intergeneration epigenetic heredity is simply contingent to this high error intrinsic to epigenesis. In my mind, this virtually excludes any evolutionary relevance of the inheritance of acquired characteristics.

Instead of the standard use of the term “Lamarckism”, we might apply it on a different part of Lamarck’s theory and call “Lamarckism” the idea that biological evolution is progressive in time. Darwin himself may have been equivocal in his writing about the evolutionary progress, while some later prominent “Darwinists” were either rejecting it, as did Stephen Jay Gould, or, like Julian Huxley and Richard Dawkins, observing it – in Dawkins’ words – “nearly everywhere”. Upon anchoring Darwinism in the contemporary interpretation of the second law of thermodynamics, we get a view on evolution of life as a permanent process of cognition, gaining and progressively accumulating knowledge. The

basic thesis of this “cognitive Darwinism” stipulates that gaining new knowledge is not deterministic, the actual knowledge knows nothing of what is hidden behind the horizon: new knowledge can only be reached by blindly fumbling in all directions. Biological species compete for energy gradients, the losers end up in a deadlock and new and more complex living forms, accumulating knowledge in a ratchet-like manner, move ahead in the evolutionary maze [5].

Darwin’s discovery has been the revolutionary breakthrough. The year 1859 divides the history of human thought into two ages: before Darwin, and the Age of Darwin.

### References

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